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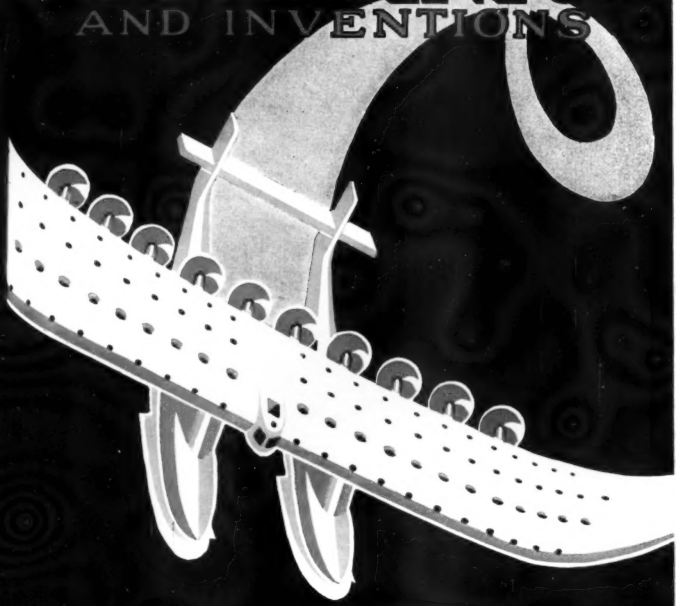

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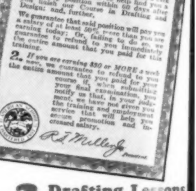

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MODERN MECHANICS AND INVENTIONS

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EDITED by EXPERTS

Listed below are the members of the Modern Mechanics board of editors, all qualified by national repute to serve as authorities. They will gladly answer questions from our readers concerning their departments. Address them in care of this magazine, Robbinsdale, Minn.

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With my new copyrighted "Picture Method," I'll help you get ready for a Big Pay Draftsman's job so quickly you will be astonished. Spare time only needed. With my method—you just watch my hands in the pictures—you **see** how it's done, and you do it yourself almost **automatically.** It's amazingly simple—yet so thorough and complete you learn Drafting from A to Z—learn it so you can sit in with the best of them on the Jobs that pay Big Money.

Sample Lesson FREE

Don't sign up for any Drafting Course until you've investigated my amazing new "Picture Method." Mail coupon for Big FREE Book and Sample Lesson. See my great Earn-while-Learning Plan—see the big Professional Drafting Outfit you get at no extra cost—learn about my Nation-wide Job Service—my positive Money Back Agreement. Mail coupon NOW!

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Send me your book "Draw Big Pay in Drafting" and some sample lessons and tell me more about your "Picture Method." This does not obligate me in any way.

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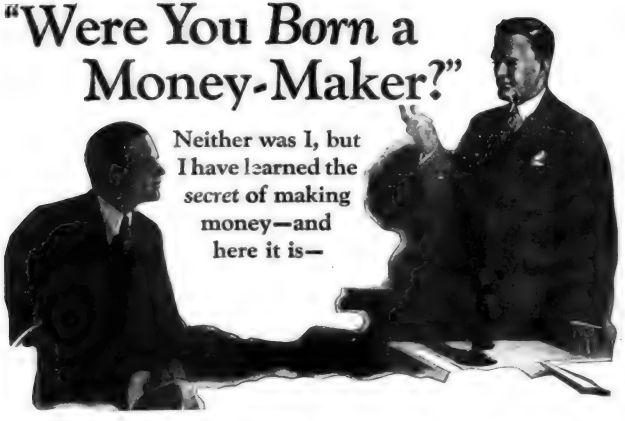
Associated with the L. L. COOKE SCHOOL of ELECTRICITY In Helping the Working Man earn More Money

"Were You *Born* a Money-Maker?"



Neither was I, but I have learned the *secret* of making money—and here it is—

I'M going to let you in on a little secret, Tom. It ought to be worth at least $5,000 a year to you, and I'm not going to charge you a single penny—

"When I was your age, I was always wondering why the boss never seemed to take much interest in me. Every six months or so I would hit him for a 'raise'—and once in a great while I would get an extra $5 a week. But the big jobs—the jobs that paid real money—always went to someone else.

"Then something happened that set me thinking—

"Bob Harris, who had started at the same time I did, was promoted to the very job I had picked for myself—salary $6,500. I knew Bob didn't have any more natural ability than I had—yet the fact remained that he got the place. And I had to admit he was better able to swing it!

"Well, I took myself aside, and for the first time in my life I looked the situation squarely in the face. That night I clipped and mailed a LaSalle coupon.

How He Landed the Big Job

"And now came the big surprise—for *me*, at least.

"I had always looked upon home-study business training as drudgery. Inside of three weeks, however, I actually got to *looking forward* to those different lesson assignments. You see, instead of reading a lot of heavy, theoretical stuff, I took up case after case that represented *actual business problems*. I was shown the principles that governed them; *then I worked them out for myself*. It fascinated me, because I could actually see myself grow.

"First thing I knew, I received my first real 'raise'—then a better job—and a better one yet—

"I told you I was going to let you in on a little secret. Well—the secret is this: Always give a little more than you're paid for. And—so that you can be sure to give more, *first get more to give!*"

Send for These Free Books—They Tell You How

You want to make more money—as soon as possible—with the least lost effort.

Then there's one thing you should do immediately—you should send to LaSalle Extension University and find out how you can turn that secret into cash.

During only six months' time—as a direct result of putting that secret into practice—as many as 1,248 LaSalle members reported definite salary-increases totalling $1,399,507—an average increase per man of 89 per cent. *Find out how you can duplicate or even exceed this record.*

To aid you in this purpose, LaSalle has prepared two very interesting and helpful books and will send them to you without cost or obligation. One is a 64-page book outlining the opportunities in the business field that most appeals to you—telling you exactly how you can turn them to your own advantage. The other has marked the turning point for thousands. It is entitled, "Ten Years' Promotion in One."

Face your problem—decide the field in which you want to make a big success—then fill in, clip and mail the coupon NOW.

— — — *Find Yourself Through LaSalle!* — — —

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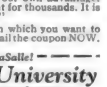
Dept. 3493-R Chicago

I would welcome an outline of the LaSalle plan, together with a copy of "Ten Years' Promotion in One," all without obligation.



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- ☐ Higher Accountancy
- ☐ Traffic Management
- ☐ Railway Station Management
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- ☐ Commercial Law
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- ☐ Credit and Collection Correspondence
- ☐ Telegraphy
- ☐ Banking and Finance
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- ☐ Personnel Management
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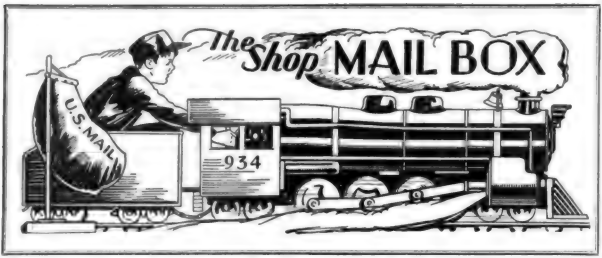


FEBRUARY was a banner month for MODERN MECHANICS!

More things than ever were included in the issue—so many, in fact, that the number of pages was increased to encompass the three great how-to-builds and the splendid features such as Capt. Eddie Rickenbacker's prophecy of the future of flying. Moreover—

The interest the magazine has provoked among those who habitually look for recreation in reading of the fascinating developments in the sciences has been nothing short of remarkable. The MODERN MECHANICS "bug" is getting under the skin of a constantly increasing number of red-blooded men who sense the romance and adventure that abounds in the fields of science and mechanics. We are proud that so large a number of our readers are skilled amateur experimenters. We are proud of the fact that to them we can carry the news of developments which will be of absorbing vital interest.

An analysis of the features in February MODERN MECHANICS which stirred wide comment reveals that readers of the magazine heartily appreciate the splendid variety and authoritativeness of the articles.

The airplane how-to-builds have enlisted the interest of the skilled and embryo airplane man alike. Never, until MODERN MECHANICS entered the field, have the remarkable developments in light airplanes been presented with any accuracy. The light airplanes editor of MODERN MECHANICS had followed the development of light, low-powered airplanes for ten years when his services were enlisted. For that reason MODERN MECHANICS right now is the clearing house for information on all matters pertaining to light airplane design, building and operation. It is the pioneer in the light plane field. It is *the* authority.

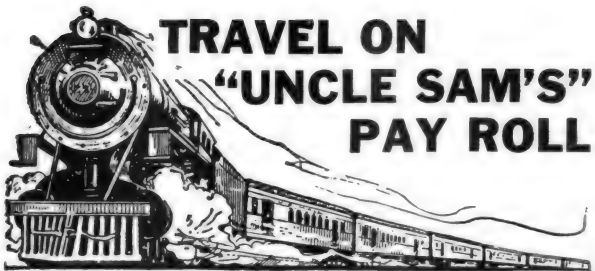
The interest aroused by George C. Henderson's story of his trip through a talking movie studio shows that the great reader body of MODERN MECHANICS is interested in every branch of science. Acoustics, photography, electricity, radio development—all these are involved when the "talkies" are made.

And not only do the Editors sense that from the interest in Gilbert Mickelson's "Aero Ice Sled," Stewart Rouse's "Heath Sportplane," and John Murray's "Wireless Controlled Battleship," are readers being served the proper menu: but when, as a month before, the Editors of the *Literary Digest* re-present for their readers Will Bradford's article, "New Money for Old," we may well believe a new note, a fresh note, has been struck in the presentation of mechanical news.

PERCIVAL MARSHALL
Model-Making Editor

What do you readers think would interest you? What would you like to see presented? Maybe there is an interesting flash of news, or some unusual development you think our readers should know about.

(Continued on page 16)



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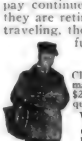
These are steady positions. Strikes, poor business conditions, lockouts or politics do not affect them. U. S. Government employees get their pay for full twelve months every year. There is no such thing as **"Hard Times"** in the U. S. Government Service.

ALLOWANCE FOR HOTEL EXPENSES

Railway Postal Clerks now get $1900 the first year, being paid on the first and fifteenth of each month. $79.16 each pay day. Their pay is increased $100 and $150 a year. The maximum is $2700 a year, $112.50 each pay day. They get extra allowance for hotel expenses when away from home.

PAID VACATIONS

Railway Postal Clerks, like all Government employees, are given a yearly vacation of 15 working days (about 18 days). When on runs they usually work 3 days and have 3 days off duty or in the same proportion. During this off duty and vacation, their pay continues just as though they were working. When they grow old, they are retired with a pension. As Railway Postal Clerks are continually traveling, they have an excellent chance to see the country. They are furnished with a railroad pass for official business.



City Mail Carriers—Post Office Clerks

Clerks and Carriers get $1700 the first year regular and automatically increase $100 a year to $2100 with further increase to $2300. They also have 15 days vacation. Examinations are frequently held in the larger cities. City residence is unnecessary.

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Compare these conditions with your condition, perhaps changing positions frequently, no chance in sight for PERMANENT employment; frequently out of a position. DO YOU EARN $1900 EVERY YEAR? HAVE YOU ANY ASSURANCE THAT A FEW YEARS FROM NOW YOU WILL GET $2700 OR MORE A YEAR, EVERY YEAR?

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YOUR Future in the Air!

THE future of aviation is tremendous—is assured. *But what about YOUR future in it?*

What do you see in the skies for yourself? A career of thrilling work with big pay and a glorious future can be yours in the *world's fastest growing industry!*

Aviation has passed the stage where ordinary training methods mean anything. *Where* you are trained, and *how* you are trained, will determine your place in Aviation a year—two years—five years from now.

It costs you *no more* to receive your training at the world's *largest and most elaborately equipped civilian air school!* Parks Air College, nationally recognized, is weekly sending out graduates to *good* jobs in the industry. Parks-trained pilots are making $700 per month and up!

One organization alone has agreed to take 200 of our graduate pilots by spring!

The photos on this page give you just a *few* glimpses of Parks Air College. Located in St. Louis, the recognized center of aviation in America, Parks Air College has facilities and opportunities undreamed of until you see them with your own eyes.

Twenty-six licensed training planes; fifteen transport pilots, over $150,000 worth of training equipment; hangars, classrooms, restaurant, recreation hall, etc.—Parks is like a great university!

You get flying instruction *every day* on brand new training planes equipped with OX5 and Whirlwind engines, fitted with stick and wheel control—*thorough flying instruction that turns you out a real pilot ready for success.*

Thorough Training

At Parks Air College you are taught straight flying, acrobatics, forced landings, vertical banks, cross wind landings, cross country flying, recovery from spins, and other flight details, by nationally known transport pilots.

And in addition to flying a pilot must know aerial navigation, meteorology, aero-dynamics; be familiar with such famous engines as Whirlwind, Caminez, OX5, Velie, Wasp and others. You must know how to *take care of your own ship! All this is included at Parks Air College!*

No wonder students have come to Parks from every state in the Union and from Canada, Panama and South America! No wonder they are now coming from Honolulu, Europe, even Africa!

Big Book FREE

Our 32-page catalog, "Skyward Ho!" gives full details and all the facts about our college, about commercial aviation, and about all our courses. It contains over 100 photographic illustrations, so you *can see with your own eyes exactly how Parks excels.*

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ONE other thing which has appealed mightily is the method of editing. Readers have confidence in the accuracy of a magazine edited by such experts as comprise the editorial staff of MODERN MECHANICS.

As ar example of the qualifications possessed by MODERN MECHANICS Editors, let us take one case in point, Mr. Percival Marshall, whose photo appears on page 12.

Mr. Marshall is the Model Editor. There is no better known name than his in the realm of model making and light machinery. Himself a successful publisher and active man of affairs, he is eminently fitted for guiding this department of MODERN MECHANICS.

Personalities are always interesting. At the risk of possibly offending Mr. Marshall, who is a characteristically modest individual, let's enumerate a few of his major "crimes"!

One of his closest friends writes:

Percival Marshall is the Editor of "The Model Engineer" and of "The Model Railway News."

He began his technical career by winning a scholarship at the Finsbury Technical College, London, where many of the leading British engineers have graduated. He took the Diploma in Mechanical Engineering and then spent several years in engineering shops and drawing offices in England and France. He continued his technical studies meanwhile and gained many additional prizes and diplomas. Having a strong bent for technical journalism he joined the editorial staff of a hardware trade paper, and later on edited a photographic paper. He then founded "The Model Engineer" and a technical book-publishing business, which he has continued to conduct ever since.

He is a Companion of the Institution of Mechanical Engineers, a Past-Chairman of the Junior Institution of Engineers, and a Past President of the Society of Model and Experimental Engineers. He has written several highly successful text-books on lathe work and other branches of practical mechanics.

He has taken a leading part in the business paper publishing field; for five years he was chairman of the Council of the late British Association of Trade & Technical Journals, and at present fills the position of Executive Chairman of the most important periodical and trade paper publishers association in Great Britain. In 1920 he travelled through Canada with the Imperial Press Conference as the official delegate of the business papers of Great Britain.

His recreations are business and golf.

Quite recommendation enough for one man! But now for other letters.

Harold T. Quinn, Dolton, Ill., writes:

I am writing this letter to let you know that I am glad that I have found such an interesting magazine as Modern Mechanics. I notice on page 154 of the January, 1929, issue an article on making a model aluminum gas engine by Elmer Wall. He countersinks the spark plug to make it look smaller. I would like to advise him that he can secure a midget spark plug made by the Robert Bosch Company which should look very much more in proportion to the engine than the large plug shown. The Bosch plug measures only about an inch and a half in height and the thread is only about 7/16-inch.

Yours truly.

Harold T. Quinn,
Quinn's Cycle and Repair Shop.

We are glad to pass this information along, and only yesterday we received a letter from Mr. Wall showing us the new high speed four cycle midget gas engine he is building for our readers. On this engine, which is truly a darb (turns 4,300 r. p. m.), Mr. Wall has used the new Champion Midget. So there you are, you model fans. And the Wall engine is coming! Another one!

And for next month! Colonel Harold F. Hartney, famous American war time ace, has written a remarkable story called "Thrills of War Time Flying." Col. Hartney, who had a lot of hours with the British before America joined forces with the Allies, has some interesting dope up his sleeve on the novel repairs made by stricken aviators who were forced to land in enemy territory. You'll chuckle a bit and tingle a bit when you slide into this yarn!

Major Arnold, a close friend of Orville Wright, tells us "Who Really Flew First." The Major tells of a letter written by the Wrights to an aviation fan before they flew which sheds some light on what the Wrights thought of Langley as an aeronautical engineer.

And—of course—there'll be a great how-to-build on the Russell Light Monoplane. Complete blue print plans, pictures, and all dimensions.

You cannot afford to miss April Modern Mechanics!

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NOW comes an amazing invention that is revolutionizing lamps! At last, a lamp that is adjustable—that ends eye strain and poor light caused by stiff-necked lamps. Already thousands of homes, work shops and offices have installed this sensational lamp that is almost human.

So powerful is its demonstration that agents' profits are leaping sky-high. And now the inventors are distributing samples and demonstrating outfits to agents and spare time workers: backed by the most unique direct selling plan ever offered. So quickly does this plan make money for agents that even inexperienced demonstrators are making $35 to $100 a week in spare time. Mail coupon for full details!

Nineteen Lamps In One

There are nineteen places in the home where this new-type lamp serves the purpose better than a stiff-necked lamp, dim overhanging bulb or flashlight. The base unscrews and clamps anywhere—on a work bench, radio set, desk, bed, or bathroom mirror. A gentle touch bends the stem and tilts the shade to throw a powerful close-up light for sewing, shaving, reading, garage, kitchen or shop work. Note the illustrations.

AGENTS: $20 A DAY

H. M. Oehlen writes that he has made $80 in eight evenings. Miss Mabel Adley made $25 in two hours, demonstrating in one office. Hartman made $19 in one day. Zinn has sold half the people in his county. Other agents are making even more, selling to church bazaars, and at carnivals, county fairs, etc.

The Falcon Lamp has a complete line to suit every taste. Two metal lamps (bronze or ivory finish lamp and base) and four choices of Parchmentex shades (painted in genuine oils and up to 7 or 8 colors). The prices are amazingly low—made possible by the huge volume of a well-established company. Size 11½ inches high. Fully guaranteed.

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A. Neely Hall Introduces Himself in a One-Page Autobiography

A. Neely Hall, editor of the Boy's Workbench department, snapped in a corner of his workshop.

THE SECRET of handling "kid stuff" may be in getting an early start. I began with a simple tool outfit—knife, fork, spoon and tooth cutter, to which a hammer was added at the tender age of two. I drove nails without pounding fingers, by the simple expedient of holding the hammer with both hands. A saw was deemed too sharp, but a butcher knife was available when nobody was looking, and it substituted. The wooden stationary tubs had tops that made a good bench. A vise was lacking until about the time I graduated into suspenders, when I fell heir to a second-hand rig and installed it. Next wash day a flood in the laundry disclosed the fact that the vise screw entered the tub below the water line. But a cork bung corrected that little bungle.

We ran the gamut of the usual boys' hobbies. But interest centered on the unusual, or something better than the other fellow had pulled—a circus with tent, sawdust ring and other appurtenances, puppet shows with scenery and accessories, a toy factory, printing shop, a monthly magazine.

The upshot of the amateur publishing business was that the magazine prospered three years, at the end of which time its biggest asset, my brother, turned illustrator, and I drifted into this game of telling boys how to make things.

After high school days, it was decided what with my building bird houses, kennels and mice cages, I should be able to design fine homes and skyscrapers, and write building specifications, I became an architect's draftsman, and attended night school. But writing continued as a hobby, and occupied week ends, holidays and summer vacations. In the course of a decade a proposition from a magazine decided me to strike out in the writing game. Within a month the magazine gave up the ghost. But I had received royalties from my first book, and before long I hit upon the idea of syndicating articles, and succeeded in persuading a small list of metropolitan newspapers, country papers and juvenile weeklies to take on my stuff. This series was soon enjoying a circulation of more than two million a week. Magazine accounts came and went, with changes in editorial policies, but the demand for articles increased, and with the thirteenth book for boys now in preparation, my daughter asks suspiciously, when I suggest a ride to Mrs. Hall "Where to, Daddy? Airport, mail train, post office or express office?" At ten years she has acquired that awful business-first complex.

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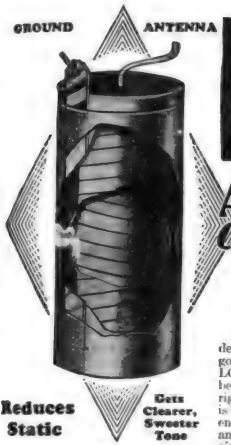

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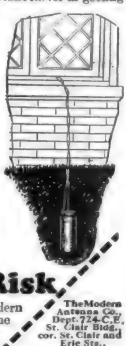

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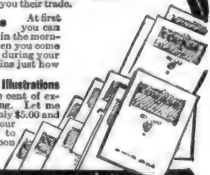

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This queer little device doesn't just chop a ragged hole in the top of the can. It cuts the entire top completely out, clean as a whistle! The machine takes hold of the can—opens it—flips up the lid so you can grab it—and gives it back without any sharp edges to snag your fingers. You just put the can in the machine—turn the handle—and almost instantly the job is done!

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Everyone knows how women detest the dangerous old-style can opener. Imagine, then, how they welcome this startling new method—this *automatic* way of doing their most distasteful kitchen task. Men, honestly I'm not exaggerating one bit when I tell you that not ten words are necessary to sell any of them! All you do is hand your demonstrator to your prospect and let her try it! She sells herself in ten seconds by the clock—and you pocket a nice, fat profit! Yes, really, it's just that simple and easy! That's why $75 to $150 a week is easy anywhere.

Opens Any Can in a Jiffy

You just fasten the can in the holder and turn the handle. Nothing complicated, nothing to get out of order. Opens any can, square, round, or oval, in a few seconds. And, men, IT'S PATENTED, so there is no competition.

Act Quick for Free Trial Offer

I don't care whether you're an "old timer" or just breaking in—the quickest, easiest money of your life is waiting for you now, right here! That's a mighty strong statement. But all I ask is a chance to prove it at my risk. I know this proposition will coin money for you so fast that it will make your head swim! Territories are closing fast. The Free Test costs you nothing. Just mail me the coupon and I'll shoot you the most sensational dollar making plan you ever heard of. Mail it today! Right now!

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Works like magic. Puts a razor edge on any knife or tool in a few seconds. Anyone can use it. Sharpens scissors, too. The coupon brings full details.

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SPARE TIME

$9 First Half Day

"The first afternoon I received my Speedo outfit I made $9."
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PART TIME

$30 in 3 Hours

"I worked about three hours and took 25 orders. This is certainly a money-maker." **O. C. Gregg, Wyo.**

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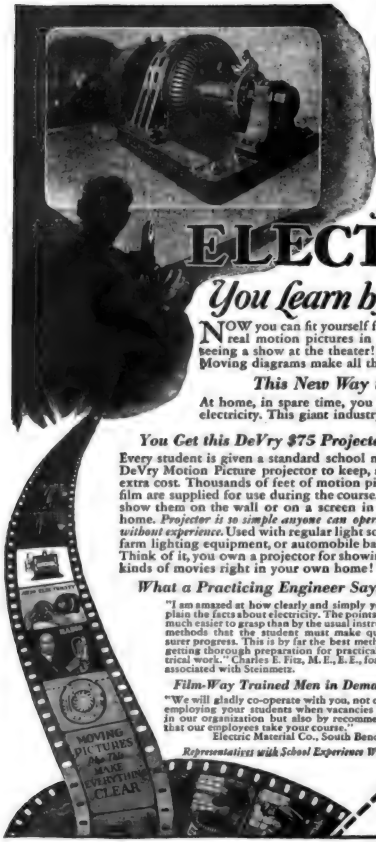

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You Learn by Seeing it Work

NOW you can fit yourself for a big pay job in electricity by watching real motion pictures in your own home! Easy and fascinating as seeing a show at the theater! You see electrical machinery *in operation.* Moving diagrams make all the facts easy to understand.

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Film-Way Trained Men in Demand

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TAKE THE FILM WAY TO *Bigger Pay*

"White collar men" need manual recreation. Building motors and light airplanes is a popular hobby these days.

Have a HOBBY!

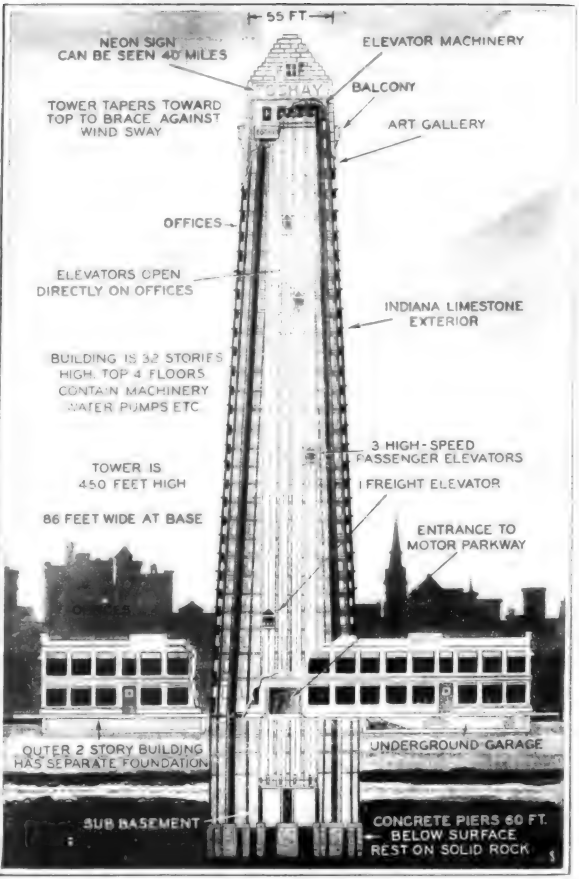
THE GREATEST developments in history have grown out of discoveries made by men who were "riding a hobby." Edison's phonograph and electric light were produced in a home workshop; Bell discovered the telephone while experimenting with a device to imitate the human voice. Hall's discovery of the electrolytic process of refining aluminum was a direct product of his hobby—chemistry. History is paragraphed with countless incidents in which men vitally interested in some subject—men who were riding hobbies—stumbled upon results of far reaching importance.

MODERN MECHANICS is dedicated to the proposition that the hobbyists of today are the most alert men of the nation. It is dedicated to developing and fostering the instinct of boys and men to build, to learn, and to enjoy the fruits of creative work.

It matters little what a man's interest is. There is something to be learned, self realization to be gained in following a hobby. The golfer trains his body and mind by a study of the science underlying golf strokes. Engineers realize their dreams by building great bridges and marvelous machines—in model. The radio fan vents the human urge to conquer nature by building a set which brings in stations half a world away. The Lindberghs of tomorrow become air-minded by their study of airplane building.

HAVE a hobby! A man's bread and butter work is the better for it. He is worth more to the world and to himself. Modern Mechanics is dedicated to the hobbyist. That is why the editors seek the best photos, news and hobby-projects that money can buy. That is why Modern Mechanics is published. It is the reason we say, "Have a hobby"!

—THE EDITORS.



Unique features of a new skyscraper which was recently built in Minneapolis, Minn., are shown here. Note the elevators in the center, separate foundation and outer 2 story building which runs to the street line, and underground garage.

UNIQUE SKYSCRAPER
Built Like a Monument

IN MOST large cities of the United States the municipal authorities have decreed that skyscrapers must be built in the set-back style—that is, the succeeding stories must be set in from the base of the building so that the structure takes on a pyramidal shape. The purpose of this regulation is to prevent towering buildings from turning the city streets into dark narrow canyons by shutting off the sunlight. The set back style of architecture also assures an ample supply of light for the occupants of the building.

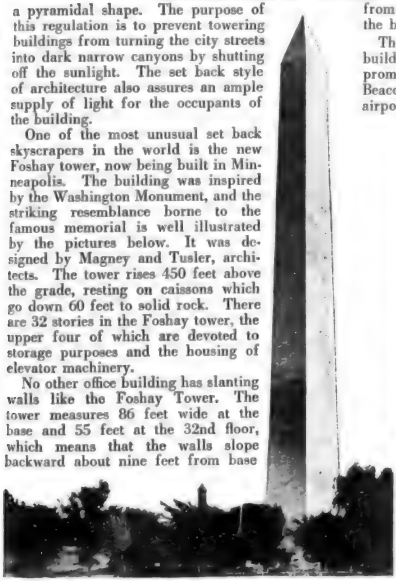
One of the most unusual set back skyscrapers in the world is the new Foshay tower, now being built in Minneapolis. The building was inspired by the Washington Monument, and the striking resemblance borne to the famous memorial is well illustrated by the pictures below. It was designed by Magney and Tusler, architects. The tower rises 450 feet above the grade, resting on caissons which go down 60 feet to solid rock. There are 32 stories in the Foshay tower, the upper four of which are devoted to storage purposes and the housing of elevator machinery.

No other office building has slanting walls like the Foshay Tower. The tower measures 86 feet wide at the base and 55 feet at the 32nd floor, which means that the walls slope backward about nine feet from base to top. Total cost of the structure is slightly over $2,000,000.

The elevator shaft runs down the center of the building so that each office has an outside window. Being set back in the middle of a block, the occupants of the tower are not bothered with dust and noise from the street.

A garage is provided underneath the tower which is entered by an incline from the street. It is possible to take an elevator from the garage to any office floor in the building.

The unique design of the new building makes it one of the most prominent landmarks in the city. Beacons pointing toward the city's airport are placed atop the structure.



These scale photographs show how closely the Foshay Tower office building has followed the design of the Washington Monument in its construction. The Foshay Tower is 100 feet shorter than the Monument. It is the only office building of its kind in the world.

Air Battleships of Our

Lieut. Com. Rosendahl, who commands the Navy dirigible Los Angeles and who was one of the survivors of the ill-fated Shenandoah when it collapsed four years ago while flying over Ohio, speaks as a recognized authority on lighter-than-air craft in making the startling predictions of aerial developments which appear in the pages below.

C. E. Rosendahl

WHAT will be the appearance and design of the floating liner of the air by the year 1950? What will support it and drive it through the air at the high speeds required to cover the vast distances on its route over land and sea? How many passengers may travel from continent to continent high above the earth within the course of a few hours? How will giant airships serve to defend the country in time of war?

An era of experimentation is about to produce practical results. On the basis of knowledge and experience gained in the construction of pioneer ships, it is possible to predict—with a fair degree of accuracy—the future of the airship.

Problems which have long confronted experts are now being solved and will result in marked changes in the speed, shape of hull, type of propellers, motors, structural design and terminal facilities.

There will be, of course, differences in engineering detail between a large passenger ship and a military ship. Facilities for passengers and freight will be replaced by the grimmer things of war, machine guns, bomb racks, and aerial torpedoes. Just as a kangaroo carries her young, the giant of the air will carry within the ship airplanes that may be released or picked up at will.

In peace time these planes will serve to load and unload passengers and mails while the mother ship is in flight. In war these planes will serve both for attack and defense.

A fleet of airships for patrolling, scout-

Next WAR

by Lieutenant-Commander C. E. ROSENDAHL

ing and reconnaissance duty at sea will prove an invaluable arm of our naval forces.

As a protection against airplanes the airship would carry machine guns and even light artillery mounted on top, in the nose, in the tail and in the control car. Filled with the safe helium gas, the puncture of several gas cells by machine guns or shells would do little harm. The airship with a ceiling of over 20,000 feet can largely avoid anti-aircraft fire and will be able to combat airplanes from a superior altitude.

Military airships of the future will supplement the work of airplane carriers on account of their greater speed and will aid in the concentration of airplanes as needed.

The dangers that the future air liner will encounter will be relatively unimportant. The fire hazard will be almost entirely non-existent, for filled with helium gas the ship may safely ride through lightning, and shell-fire. Pioneer ships such as the *Los Angeles*, the *Graf Zeppelin* and the *Shenandoah* have had their value in solving structural problems.

A ship six times the size of the *Los Angeles* or four times the size of the *Graf Zeppelin*, with a lifting gas capacity of 15,000,000 cubic feet will probably be profitably feasible. This type of airship will be quite different in shape from the *Shenandoah*. The future air liner will be comparatively much shorter and fatter.

This squat construction will give added strength and will enable the craft to with-

stand fierce storms. The ratio of diameter to length will probably remain in the vicinity of one to six.

The control car will be built into the structure as far as possible. Passengers' compartments, promenade decks, smoking rooms, and dining rooms will be located along two or more lateral corridors, extending far back along inside the ship.

The value of this improvement of multiplo corridors will be readily understood by a simple comparison. Take a single lead pencil and see how easily you can break it in your fingers. Then take two pencils or three pencils, wire them rigidly together and see how much greater is the pressure needed to break them. Similarly the introduction of multiple corridors laid on three

modification. It is quite possible that the present type of aeronautical engine may be replaced by one using oil similar to the Diesel type. Utilizing oil as a fuel rather than special gases or gasoline, will increase safety and fuel may be more easily handled and obtained.

Gear transmissions installed in the engine room will be refinements upon the already highly developed arrangements for easy maneuvering. Reversibility and highly variable speeds will be possible with no more effort than that required to operate a ground vehicle.

Tilting and variable pitch propellers—on which research work is now under way—located just outside the hull, will help force the ship upward or downward as de-

Uncle Sam has already taken a step forward in the development of air battleships such as Commander Rosendahl describes. Contracts have been placed with the Goodyear-Zeppelin Corporation of Akron, Ohio, for two fighting dirigibles which will be the largest in the world when completed—more than two and a half times as large as the Los Angeles! They will be 785 feet long, with a gross lift of 400,000 pounds and a horsepower of 4,480. They will have a cruising range of 9,500 miles without refueling, and will develop a speed of 85 miles an hour.

or even four keels greatly increases the strength of the ship.

In attaining ships of greater sizes there will be evolved a new type of framework which renders the crew of the future airship immediate access to every part of the ship for inspection and repair.

This framework will be strong enough to take all stresses without the assistance of wire bracing. It will consist of rings with a sufficient section to afford intercommunication between corridors and to permit the installation of the power plant entirely within the hull.

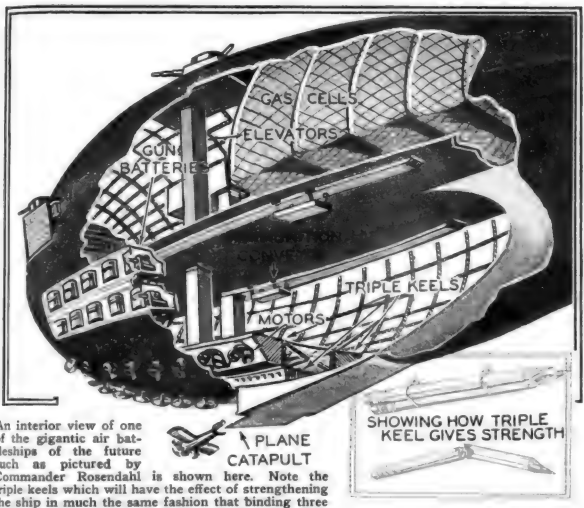
It is doubtful if any helium filled ship constructed after 1935 will have its motors outside the hull. Aside from greater ease in making repairs this arrangement will lower the air resistance to a minimum since only the propellers will project beyond the sturdy lines of the ship's body.

Engines themselves may undergo serious

sired. This feature will be of great importance in starting and landing. It will also permit carrying more paying load and will avoid the loss of lifting gas when the ship has to be forced down.

It is quite possible that a new alloy will prove practicable that is lighter and stronger than that now in use. Electron metal, an alloy of magnesium, is now being investigated in Germany and elsewhere for use in propellers and other special parts.

While experiments are now being carried on in connection with metal covering for the hull, the adoption of this generally for naval and commercial craft will not be in the immediate future. New methods for treating and preserving fabrics and the installation of the improved framework will virtually eliminate present day objections to fabric covering. Eighty per cent of the original fabric placed on the *Los Angeles* is now still in use after five years.



An interior view of one of the gigantic air battleships of the future such as pictured by Commander Rosendahl is shown here. Note the triple keels which will have the effect of strengthening the ship in much the same fashion that binding three pencils together increases their strength many fold.

It is probable however, that the great airships of the future will all have one cover for retention of the lifting gas and a second independent water-proof and fire-proof outer cover to form a smooth surface over the framework.

The multiple cell system for holding the lifting gas will be continued. Difficulties in securing the proper materials for the construction of these cells have been removed by the invention of several cheap substitutes which are being developed to a practical status.

The greatest advance will be in terminal facilities. Large ground crews will eventually become unnecessary. Mechanical handling will enable any ship, no matter how large, to be landed and moored in practically all kinds of weather, within a few minutes.

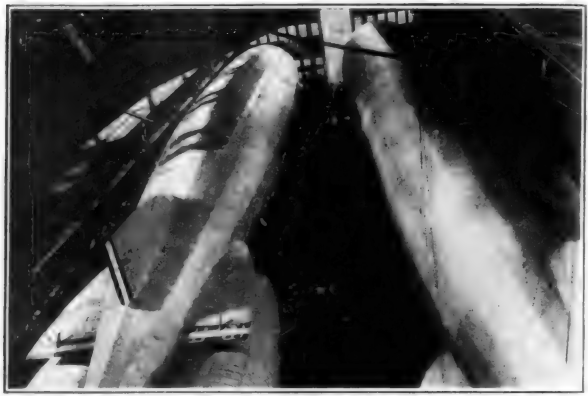
I believe that the low mooring mast will eventually be adopted generally. The ship, resting close to the ground, will there be subjected to less loads and may be safely handled by various devices to control the craft horizontally and vertically.

Hangars will eventually be used only as "dry-docks" and constructed in accordance with correct aero-dynamic principles. The revolving platform, on which the hangar can be turned in any direction desired, is thoroughly practical.

The airship of the future will provide the best in comforts of travel. There will be no dirt, noise, vibration, or smoke, and the motion, when there is any, will usually be a very mild, gradual pitching. There will be ample comforts for reading, writing, card playing, promenades, and luxurious staterooms. The ship's kitchen will furnish as satisfactory a menu as desired.

The cruising speed of the future airship will be about 100 miles per hour. A cruising radius of 10,000 or 12,000 miles is not far distant.

A man could leave New York, Saturday morning, arrive about two days later on



Interior view of the Lakehurst hangar housing both the Los Angeles, at the left, and the Graf Zeppelin. Beneath the tail fins of the Los Angeles two small Navy blimps may be seen. This view was taken at a height of 300 feet above the floor. Dirigibles now being constructed for the United States government will be larger than either of these huge ships.

Monday at London or Paris, spend four days on his business affairs, leaving there Friday morning, taking about three days on the return against the prevailing westerly winds, arriving in New York again Monday morning.

From England to Egypt will require two and a half days by airship, as opposed to six days by steamer. From England to Singapore will require eight days by airship, whereas twenty-four are required by steamer.

Even the weather—at times the foe of all instruments of transportation—will be successfully combated. With a new type framework for the hull, improved fabrics for the cover, rain and moisture will become only an inconvenience. Changes in temperature will present no special operating difficulties. It will not be necessary to deny passengers and crew the comfort of heat in their quarters. Plans are already under way for the installation of electric and other methods of heating on ships under construction.

An increasing knowledge of wind conditions will enable future airship pilots to actually benefit from flying into a storm area in order to take advantage of the winds. Shrewdly considered, such maneuvers result in a considerable saving in fuel and time of flight.

Lightning, hitting a ship, is distributed and dissipates itself harmlessly through the perfectly bonded metallic structure. Fogs are of less seriousness to airships than to airplanes and with the improvements to be made in the future in landing facilities, this element will become of even less importance than it is today.

And what about new construction in the United States? At present our only large airship is the *Los Angeles*. The last Congress authorized as a part of the five-year aircraft building program two large naval airships of about 6,500,000 cubic feet gas capacity—larger even than the new British ships.

With these America is in a position to gain supremacy in the building of giant airships as instruments of national defense and as commercial carriers. These two new ships will mark the first steps in the new era.

Barrel and Pipe Make Handy Mechanical Sprinkler

USING an old milk can carrier, a cider barrel, a gate valve and a length of iron pipe, the head gardener at a mid-western country club built a mechanical sprinkler that saved his men the drudgery of carrying sprinkling cans to parts of the golf course that could not be reached by the water system. The barrel is filled with water at the nearest pipe connection and then rolled to the place that needs attention. After opening the gate valve the operator pushes the rig along, sprinkling a wide swath as he goes.

CEMENT PROTECTS IRON

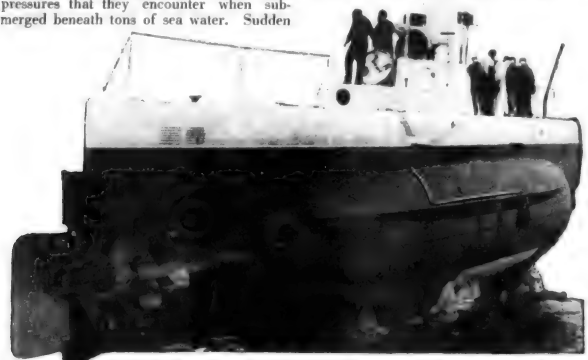
Tanks of iron or other metal can be protected against corrosion by painting them with a thin mixture of Portland cement. This is nothing but cement and water and is applied to the tank just as paint would be, with an ordinary paint brush.

SUBMARINE RESCUE VESSEL READY FOR TESTS

A SPECIALLY equipped submarine designed for undersea rescue work, possessing such novel features as a trap door in the bow and a decompression chamber, has recently been completed for the Navy. The sub is named "Defender" and is shown in the photo below.

When submerged, divers can enter or leave through the special trap door in the bow. The decompression chamber is a device employed to subject divers to the same pressures that they encounter when submerged beneath tons of sea water. Sudden changes in pressure produce a disease known as the "bends" because of its cramping effect on the muscles. The decompression chamber permits the body to become accustomed to the pressure gradually.

When a diver enters the chamber the pressure is equal to that of the air. Water is admitted slowly until he has gradually become accustomed to the ocean pressure. The reverse of this operation takes place when the diver returns from his dive.



Complete Camper's Kit Fits Into Small Suit Case

IMAGINE opening up a valise that carries all the accessories required for a camping trip. The photo below shows such a valise as it appears when the camp cook has opened it up and is ready to set up shop.

This valise is only slightly larger than the standard traveling bag and carries a table, chairs, cooking utensils, knives, forks, spoons, thermos bottles, cups, saucers, plates, and in fact all the dishes, kitchen tools, and what not, that the most fastidious camper could desire.

A French inventor devised this compact kit for the use of a friend who took frequent camping trips, but like many campers wanted to have all the conveniences of home. With all the equipment that a man could desire, this kit should make for perfect camping trips.

BLAST-FURNACE SLAG MAKES MINERAL WOOL

MINERAL wool, sometimes called silicate of cotton, is a fibrous substance made from blast-furnace slag by sending a blast of steam through it while still molten. It is widely used as a heat insulator, fireproofing material and sound-deadener.

NOVEL PONTOONS ACT AS WAVE STABILIZERS

THE UNIQUE amphibian shown below constitutes a radical departure from the ordinary type of hydroplane. The chief feature of this machine is its stabilizing pontoons on either side of the main hull. When the waves from either side strike the craft these pontoons act as shock absorbers and keep the wings from hitting the water.

The greatest obstacle facing the inventor was the huge waves that the Atlantic can "kick up." The hydroplane started a test run off the coast of France and was going nicely until some big waves came along. The plane jumped from the top of one into the middle of the next and was badly damaged.

Unique German hydroplane that attempted to cross the Atlantic as it appeared shortly before starting on its test flight, which ended in a crackup.

World's Longest Bridge Boasts a Span of Five Miles

SPANNING five and a half miles of water with a bridge is an engineering feat of no small note, yet the engineers in charge of the Atlantic Coastal Highway have accomplished it by constructing the longest bridge in the world. The Newport News-James River bridge is constructed of steel reenforced concrete, with a huge lift at that point where the bridge crosses the main river channel.

The photo shows a bird's-eye view of the bridge as it was nearing completion. The towers of the lift, which raise a section of the bridge to permit steamers to pass, can be seen near the top of the picture and indicate the size of the lift as compared with the remainder of the bridge.

IMPROVED COMPASS

THE Aeronautic Instrument Section, Bureau of Standards, has designed what is described as an improved form of the Heyl-Briggs earth-inductor compass, and an experimental instrument is reported to be nearing completion. The compass is to be installed on a plane for service tests.

FILM VENDOR IS NEWEST

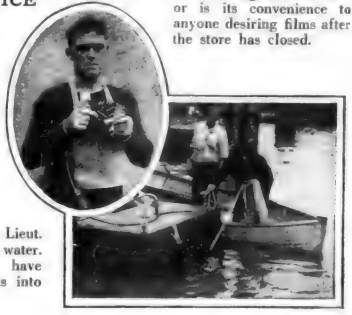
CERTAIN stores in Copenhagen, Denmark, have found that the sale of photographic films can be materially increased by placing automatic selling machines in front of their stores. The new vendor is similar to most of the coin-operated machines that are in use today.

Different sized films are carried in stock by the machine, each being controlled by a separate coin slot. The chief advantage of this vendor is its convenience to anyone desiring films after the store has closed.

NEW BREATHING DEVICE

TWO NAVY divers recently tested a new breathing device which was designed to permit the rescue of crews of sunken submarines. It consists of an oxygen bag and a mouthpiece. Lieut. Momsen, submarine and diving expert, is shown in the oval at the right just before he made the test, which entailed a descent of 110 feet in a diving bell and then a hand over hand ascent on a rope. The diving bell and control rope are seen in the photo at the right; Lieut. Momsen is just going down into the water.

The recent submarine disasters have brought the best of inventive genius into the field of rescue work.



How to be a Scientific

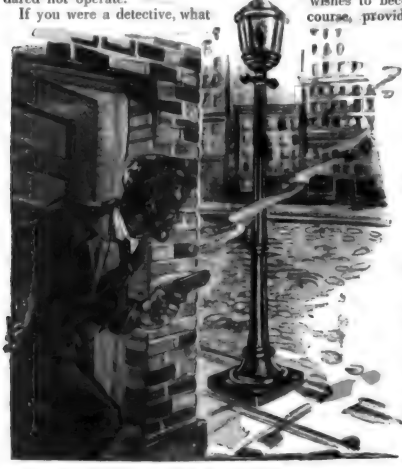
By GEORGE C. HENDERSON
Author of "Keys to Crookdom," etc.

In this fascinating article, the first of a series on vocational subjects, Mr. Henderson gives us a glimpse behind the scenes of the modern detective's workshop and gives some pointers on how to train for the profession.

THERE'S a clue to every crime mystery. Truth is as mighty as the law of gravity. It breaks through the strongest wall of lies. There has never been a perfect crime. There never can be because a thing that is false cannot be perfect.

The detective's job is to find the clue. Often it is deeply hidden like the bullet in Joe Burn's brain. They dared not probe for that bullet, yet a man's life hinged upon it. Ralph McAhren was held for the shooting. They found a .32 calibre revolver on him. McAhren protested his innocence. "We've got to prove that bullet is a .32," said the district attorney. Yet they dared not operate.

If you were a detective, what would you do in a case like that? You would have to appeal to science, of course. The outstanding detectives today are scientists. It is of this kind of detective work that I am writing. To become the "flat foot" type you merely get a job with one of the many law enforcing agencies—the police, private patrols, sheriff, district attorney, railroad police, internal revenue, border patrol, prohibition enforcement, narcotic officers, U. S. marshal, secret service, department of justice—and work up by political pull, seniority and hard grubbing as at any other trade. Training with these forces is excellent for the young man who wishes to become a scientific detective—of course, providing he does not stop there.

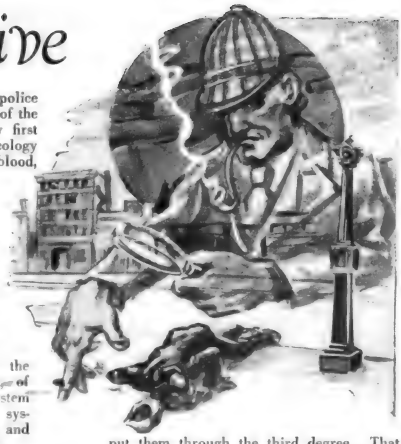


But to get back to the bullet in Joe Burn's brain. Science looked right into Joe's brain, measured that bullet, said it was a .45 and cleared Ralph McAhren. The X-ray did it.

It took a detective with a scientific turn of mind and scientific knowledge to work that out. He knew about the spectroscope. Do you?

In picking detective work as your profession, you must first consider your qualifications. Civil service rules give you the standard required of police and other official branches. If you do not come up to those standards, there are still the private agencies to consider. Or, if you have the funds and the education you can set up as an expert criminologist. The best combination would be for a man to

Detective



get a job in one of the police branches and take up a study of the following subjects: chemistry first and above all; then toxicology (poisons), identification of blood, hair, handwriting, typewriting, fingerprints, inks and the marks made by gunpowder, both black and smokeless, at various ranges. To handle many of the above subjects, he would have to become an expert in microscopy (work with the microscope) and photomicrography (the making and study of magnified photographs). Knowledge of the dictaphone, the lie detector, of scopolamin, the Bertillon system and the regular "police file" system of "mugs," handwriting and fingerprints must be mastered.

Chief Vollmer, the famous Berkeley expert, emphasizes practical experience in abnormal psychology and psychiatry—the study of the minds and motives of the diseased wretches found in jails, prisons, insane asylums and homes for the feeble minded. This is to discover why they commit crimes and what may be expected of the criminal.

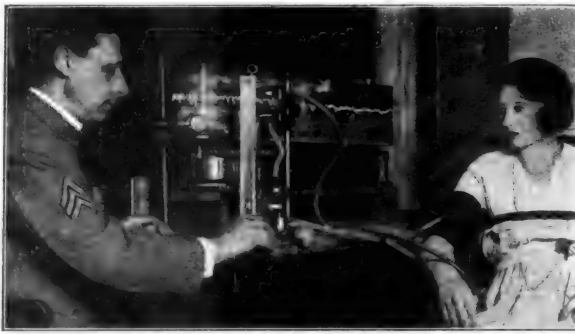
"Roping," the knack of trailing a criminal, getting his confidence and worming information out of him, is a science in itself. Men have spent their lives in learning "roping" alone.

There was the famous "Co-ed Diamond Thief" case which put Vollmer's scientific theories to a test. Fifty girls in a sorority house were under a cloud because a $500 diamond had been stolen from the dressing table of Amelia Hope, a co-ed.

Vollmer had the ticklish job of going in among those fifty sensitive girls and finding the thief. The situation at the sorority house was pitiful. A damning case had been built up on theory against a little, lonesome, blue-eyed girl, Marjorie Small. It was breaking Marjorie's heart. Questioning did no good. The chief met baby stares of innocence on every hand. He couldn't drag anyone off to the station and put them through the third degree. That wouldn't go at all with University co-eds.

Chauncey McGovern, handwriting expert, studies a disputed document enlarged through a microscope by reflected light shining through a glass table top.

"Lie Detector" Analyzes Heartbeats to Tell Truth from Falsehood



When a person lies, his heart beats faster and he breathes quicker. That is the principle on which the "lie detector" shown above is founded. This specially posed photograph shows how the machine is connected with a subject; the white lines scratched on the smoked paper record all irregularities of the pulse. This device is one of the pieces of equipment which help to make detective work an up-to-date science.

The chief fell back on science. One of his men had invented a lie detector. It was an instrument for the testing of heart beats and the regularity of breathing. John Larson, the inventor, was just a patrolman. But he had done as I am advising would-be detectives to do. He studied scientific criminology. He took a Ph. D. at the University. Incidentally I might mention that he was called East to a high paid job as a result of his studies. Vollmer and Larson claimed that when a person lied, his heart beat faster and he breathed quicker. The "lie detector" showed this up.

The co-eds were asked to submit to the lie detector as a lark. Marjorie Small, the accused girl, never faltered. But dashing, beautiful Georgia Long did not do so well. When the chief mentioned "diamonds" the lie detector pen cut a low jagged path on the indicator. The breathing indicator spurted upward, showing she had caught her breath. Chief Vollmer had the thief. But she was not convicted yet. She denied her guilt. A "shadow" was put on her trail with instructions to make his presence known to the girl. Chief Vollmer's study of psychology told him that he could break her down in this way. The man, dogging her footsteps, worked on her nerves so that she at last confessed.

E. O. Heinrich, the noted expert in the D'Autremont-Siskiyou train robbery affair, the Schwartz murder mystery and many other cases, is an example to the young man who wishes to become a scientific detective. Newsboy, drug clerk, university student, graduate chemical engineer, city chemist of Tacoma, Washington, acting as expert in criminal cases, captain of engineers during the war, chief of police of Alameda, Cal., and now a college instructor in criminology and recognized expert witness and detective—those are the steps by which he worked up to his present position. The study of chemistry played a big part in his rise.

Everyone has heard of the famous D'Autremont robbery. Thousands of dollars reward was offered all over the world for their capture. It was Heinrich who pointed the finger of suspicion at them. Bandits halted No. 13 in the Oregon mountains, shot down the engineer, fireman and brakeman in cold blood with shotguns filled with buckshot, pulled the train ahead to "spot" the mail car over a cache of dynamite and caused the death of the mail clerk who was

knocked senseless and burned to death in the explosion and fire. The bandits fled.

Canvas overshoes, a pair of old dirty overalls and batteries used to explode the dynamite were the only clues. Officers traced the batteries to a nearby garage. There they found an ex-convict, Lem Peters. The overalls fitted Lem exactly. They were covered with something that looked like garage grease. Quick work! They began to "third degree" Peters to make him give the name of his partner. Peters protested his innocence.

Heinrich was engaged by the railroad. He scraped some of the dirt off the overalls. It was not grease at all, but pitch. He took it to his laboratory. Analysis showed it was spruce pitch.

"Free Peters," was Heinrich's order. "The man we want is a left-handed lumberjack, brown haired, probably dark eyed, of medium height, rather heavy set, fastidious and rather young. He lives in the lumber region of the Pacific Northwest."

The railroad officials were astounded. They did not want to free the ex-convict. "How do you know all this?" they demanded.

Heinrich pointed to a little pile of dirt on his laboratory table. It was stuff he had taken from the overall pockets. To the naked eye it showed nothing. Under the microscope, magnified 500 times, the particles became bits of Douglas fir needles, finger nail cuttings, pine chips from the right hand pocket, leaves of the "kinni kinnick" and salal, peculiar to Western Washington and a red soil. Hair found caught on buttons was dark.

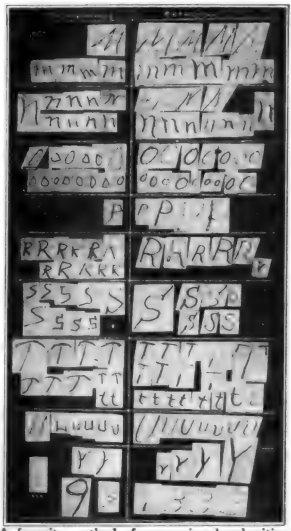
"The overalls gave me his size," explained Heinrich. "The chips, the pitch and the way the overalls are rolled to fit into lumberman's boots, told me his profession. The bits of plant indicated the locality and the hair told me he was dark."

"But how do you know he is left-handed?" Heinrich was asked.

"Chips in the right hand pocket," was the reply. "A left handed man stands with his right side to the tree while chopping. Flying chips enter the right hand pocket. His fastidiousness—well, unless a lumber jack is fastidious he does not pare his nails as those cuttings show."

Still the men in charge were not convinced. "How do you know his age or that he is not a negro or an Indian?"

Heinrich produced a chart. He was getting down to real science now. On that chart were magnified photographs of many kinds of hair. A hair is transparent so that a photograph shows the inside of it. Between his fingers he held a photograph of one of the hairs he had found on the overalls. By comparing this with the chart, he proved that the hair belonged to a young man, white, and in good health. "It could not be a negro," concluded Heinrich, "because a cross section of a negro's hair is elliptical."



A favorite method of comparing handwriting specimens is shown above. The specimens on either side of the vertical white line were written by different individuals, as is clearly shown when the specimens are placed side by side as in this instance.

The officers released Peters and went out with this description into Western Washington. It was recognized as fitting a notorious Northwestern outlaw, D'Autremont. Only recently was the last of the D'Autremont boys captured.

And remember, Heinrich started as a newsboy!

Screen Star Packs Herself in Traveling Bag

Alice Lake, screen star, demonstrates how a valise can be used as a sleeping bag.

WHEN Alice Lake, screen star, recently purchased a new traveling bag, she ordered one large enough to contain not only her wardrobe and vanity equipment, but also herself. She is seen in the photo at the left powdering her nose and demonstrating just how comfortable a seat a valise can be.

The large capacity bag is a new departure developed to satisfy the need of the present day traveler who wishes to carry a large amount of luggage on long trips, yet who does not want to bother with a trunk.

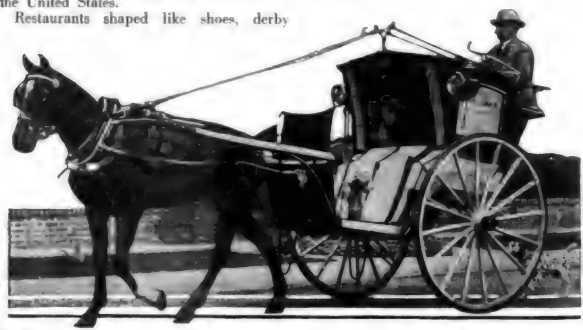
$1,000 SAVED BY OMITTING WINDOW LOCKS

A Chicago contractor saved more than $1,000 by omitting to install locks on all windows above the ninth floor of a sky scraper under construction. In an investigation it was found that few tenants in high buildings ever locked their windows.

DOG CARRYING CAB IS ADVERTISING NOVELTY

GEORGE STONE, an old time London cabby who has opened a "hotel for dogs" in Los Angeles, is seen below transporting some of his canine "customers" to the hostelry. The cab and horse were imported from England to help make the setting for the "dog hotel" more unique. Los Angeles probably has more strange advertising "stunts" than any other city in the United States.

Restaurants shaped like shoes, derby hats, windmills, and other fantastic articles may be seen on almost every corner of the movie city, and this "doggy" cab is quite in line with the advertising habits of the town. The attention which the dog cab attracts as it travels about on the city streets more than repays the canine hotel keeper for the expense incurred in fitting out the equipage.



New Hairdressing Machine Resembles a Helmet

THIS STRANGE looking device that resembles a helmet is the latest in hairdressing equipment. It is a hair dryer with a helmet attachment to circulate the heated air thoroughly around the head. The electric heating unit is in the upper part of the air tube as can be seen in accompanying photo. The young lady posing with the new machine demonstrated the advantages of the helmet attachment at the recent Hairdressing Fair in London.

EXPERT DESIGNERS DISCUSS NEW FEATURES

TWO DESIGN features which, while not new to automotive engineering, are novel in that they are being adopted into current practice, were discussed before a meeting of automotive engineers recently by Herbert Chase and D. Sensaud de Lavaud, well known designers.

Mr. Chase in his paper entitled Front-Wheel Drives, Are They Coming or Going? traced the history and development of this form of power transmission from 1862 to the present. Mr. de Lavaud discussed the possibilities of the automatic transmission in a paper describing the work that has been done to perfect the gear shifting process by engineers in Europe.

ANTHROPOLOGIST FINDS NECKLACE 35,000 YEARS OLD

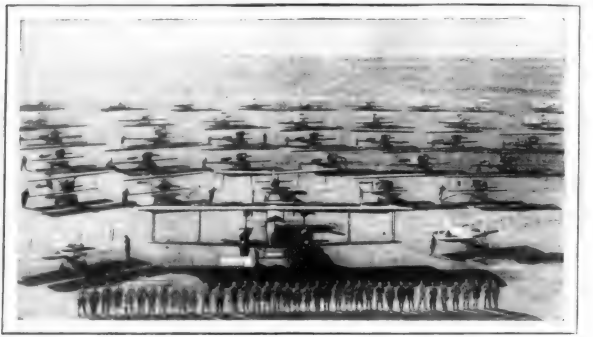
HENRY FIELD, cousin to Captain Marshall Field of Chicago and assistant curator of Physical Anthropology at the Field Museum, Chicago, has just returned to his post after leading an expedition which toured the world seeking human remains. He brought with him a necklace that is reputed to be 35,000 years old. It is composed of about 250 beads of mammoth ivory strung with pebbles, shells and the teeth of fox.

Henry Field is seen below examining a piece of the old necklace which he found recently in France.

U. S. ARMY'S NEW TANK DEVELOPS SPEED

ORDNANCE experts of the United States Army are convinced that the tank will play a major part in any war that this country may take part in. With this in mind Major Levin H. Campbell, head of the Automotive Section, Office of the Chief of Ordnance, War Department, directed all efforts toward the development of a light weight tank that would have a superior fire control and great speed. The seven and one-half T-1 model was the result of the department's work. It developed 18 miles per hour on rough ground and 23 miles per hour on road.

Forty Fighting Planes Take Part in Movie Thriller



FORTY war-time fighting planes, with the pilot and mechanic of each, are shown in the photo above as they were assembled at an Oakland, California airport to take part in a single spectacular battle scene for "Hell's Angels," the $2,000,000 Howard Hughes spectacle now being shown. The single scene in which these aerial daredevils perform is to cost more than $100,000—a record high-price for one "movie thrill." Judging from the number of planes and the line of pilots standing in front of them, the producer intends to give the public a realistic battle scene. The dogfights that these pilots will enact should be as gripping as the real thing. They will use all the tricks that were developed by war pilots, except that blank bullets will be used. All of the pilots have had military experience.

SAFETY CONTROL STICK

INSTEAD of using a monkey-wrench on the head of a student who has "frozen" to the control stick, the instructor simply pulls on the cable of this new device. M. C. Davis invented this new control stick so that the instructor by pulling a cable, can disconnect the student's stick and allow the pilot to take complete control of the ship.

This photo shows M.C. Davis with his newly invented device to prevent student pilots from "freezing" to the control stick.

PATRICIAN TO BE REBUILT

WHILE the workmen were putting the final touches on the Keystone twenty-passenger Patrician monoplane, it accidentally caught fire and was practically destroyed. Edgar N. Gott, president of the Keystone Company, received from the 40 skilled mechanics who had worked on the plane an offer to rebuild the plane after working hours without any extra pay. The men hope to have the plane rebuilt in time for the winter airplane shows.

The Patrician will be the largest plane of American manufacture, with a passenger-carrying capacity almost twice as large as the well-known Ford tri-motored ship.

Old Water Boiler Made Into Efficient Diving Suit

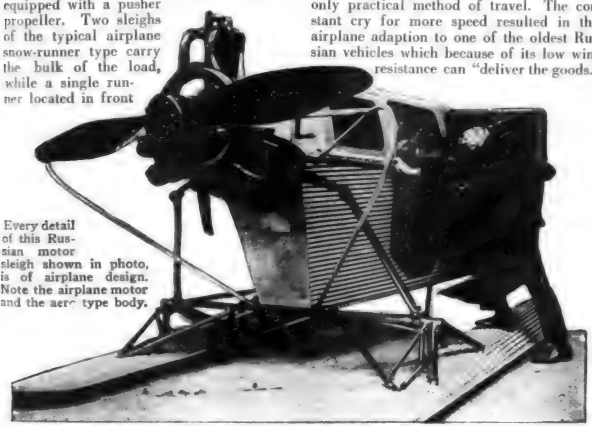
THIS complete diving suit was made from a surprisingly small bill of materials; an old water boiler, a length of heavy chain, fifteen yards of rubber tubing and a decrepit beer pump resurrected from the cellar of a saloon. With this equipment Walter Merwin of Perth Amboy, N. J., has done numerous diving jobs along the Perth Amboy water front and in various parts of the Atlantic seaboard.

He is associated with Peter Coogan in the marine junk business, salvaging copper, iron and brass from vessels about to be scrapped. The business of this partnership has prospered and Merwin could well afford a modern regulation diving suit, but he would much rather work in his own home made outfit.

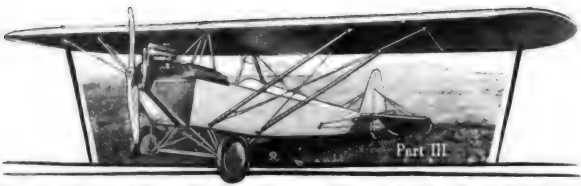
Walter Merwin made this diving suit from an old boiler and a discarded beer pump.

RUSSIAN MOTOR SLEIGH SHOWN AT BERLIN

AIRPLANE design technique was used in the construction of the Russian motor sleigh which was recently shown at the 2nd International Air Exhibition in Berlin. The body of the sleigh is modeled after the fuselage of an airplane. An airplane motor is used for power and is equipped with a pusher propeller. Two sleighs of the typical airplane snow-runner type carry the bulk of the load, while a single runner located in front is connected with the steering gear. In the frozen north of Russia, the sleigh is one of the most popular forms of transportation; in fact, during the long winter, it is the only practical method of travel. The constant cry for more speed resulted in this airplane adaption to one of the oldest Russian vehicles which because of its low wind resistance can "deliver the goods."



Every detail of this Russian motor sleigh shown in photo, is of airplane design. Note the airplane motor and the aero type body.



Trim, staunch and capable of doing any thing any ship can do, the Heath Super-Parasol is a credit to her designer. Her factor of safety is over 10 to 1.

Building the

"SUPER-PARASOL"

By STEWART ROUSE

Details of modern airplane wing building are given in this article. Modern practice in the construction of high lift panels is clearly shown. All fitting details for the Parasol are given with line drawings.

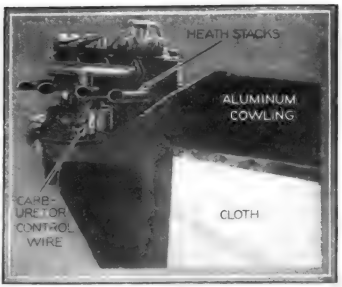
FINAL details for the building of the Heath-designed Super Parasol sport plane can now be gone into. In the January issue I told how the Parasol came to be designed and built, in the February issue I gave more of the figures of her design together with some drawings, and we, in February, left the work on the tail surfaces so that we might take them up again at this point.

We were talking about the rear spars and the ribs of the stabilizer. These bottom cap strips are connected and stiffened in their centers by a 1/4"x3/4"x3/4" block nailed and glued as shown. There are two center ribs set in diagonally almost over the rear ends of the longerons. The 3/8" square diagonal braces are installed, as shown, running from the center of the rear spar to a footing in the angle of the second rib from the tip, and the front spar. From a point on the front spar just outside the rib mentioned around to the tip of the rear spar, the outline is a quarter circle of 1/4"x22 ga. steel tubing. This is fastened to the front spar, as shown, by a couple of 5/8"x20 ga. nails driven through into the spar, and a wrapping of thin copper strap, soldered to the tube and nailed to the wood. A small block is fastened between the tips of the cap strip of the tip rib, to drive a nail into. A small strap of sheet steel is wrapped over the tube and laid up on the rib above and below for about 1", where it is nailed down with 3/8"x22 ga. flat-head nails. Then a hole is drilled through the strap and tube and a small nail is driven through the strap and tube into the rib tip.

The strap can also be soldered to the tube. The tube is fastened to the rear spar tip in the same way. Two clips of 18 ga. sheet steel hold the front spar to the longerons. Two 8-32 bolts hold the spar to the clips. A 3 3/32" bolt holds an 18 ga. "U" shaped steel clip to the top of the spar at the center.

This holds the front end of the vertical fin. It is best to put large 1/16" thick washers under all bolt heads set in wood. The front spar is reenforced by a 1/2" x 1/2" x 5 3/4" piece of spruce nailed and glued to its rear side at the center, where the bolts go through the spar. The rear spar is held to the top of the stern post with two 18 ga. 5/8" sheet steel angle brackets. The spar is held to the angles with two 8-32 bolts, which also carry a pair of angle brackets on top of the spar to hold the rudder post of the fin. The rear spar must be reenforced at the center.

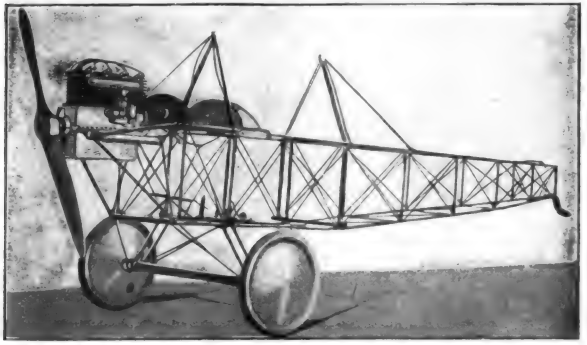
Strips of cap strip material should be glued and nailed to the top and bottom surfaces of the rear spar, between the ribs, to prevent a lumpy edge when the fabric is applied. Reinforcing blocks are attached to the front and rear spars between the cap strips of the second rib from the tip. These blocks are drilled for 8-32 bolts, each of which carries two lugs made of 18 ga. sheet steel, one on top and one on the bottom of the spar. These lugs are $\frac{3}{8}$"x1"x18 ga. sheet steel. They are bent to a suitable angle in the middle, and carry the ends of 14 ga. plated aircraft wire braces. On each side there is a pair running to a double lug on the rudder post of the fin, on top; and a pair running to a double lug on the bottom bolt of the stern post. These wires are adjusted with No. 322 turnbuckles. The fin is made in a way similar to that used in making the horizontal stabilizer. It is attached to the "U" shaped clip on the front spar of the horizontal stabilizer, and to the angle brackets on the rear. It has a reenforcing block on the front of its rear spar through which an 8-32 bolt passes, carrying a double lug on each side for the bracing wires. The elevators and rudder each have a hinge spar at the front,



Adequate cooling is provided for the motor, yet it is definitely a part of the ship and does not protrude "outdoors" objectionably. The cowling, the wire for controlling the throttle, and the special stacks are shown here.

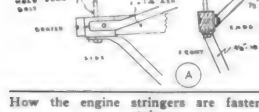
a stringer or second spar through all the ribs, with the cap strips glued and nailed to it, and an outline of $\frac{1}{4}$" x 22 ga. steel tubing. Holes are drilled on the center lines of the hinge spars of the rudder and elevators, and of the rear spars of horizontal stabilizer and fin, to take $\frac{3}{16}$" eyebolts.

Each hinge consists of a pair of these eyebolts with the eyes laid together and a clevis pin pushed through for an axle. The



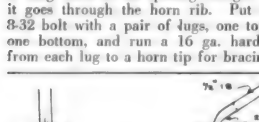
This is how the fuselage of the Super-Parasol looks before the cloth and dope are applied. The wheels are shown with their covering, however. Note the absence of curved work in framing the tubing. This makes for extreme strength and for ease in fabrication. The turtleback formers are merely half bulkheads fastened at the first and second strut panels.

clevis pin must carry a thrust washer and a cotter pin for locking. The elevators have three hinges, with one hinge next to the horn rib. The horn is made of a piece of 18 ga. sheet steel nailed to a piece of 1/8" plywood. Cut out a piece of steel 1/8" larger all around than the side view of both top and bottom horns together. Cut out a piece of 1/8" 3-ply plywood exactly the size of the horns. Nail the sheet steel to the plywood. Turn the edges of the steel over the wood all the way around to make a filler of the wood. Drill each horn for the control cable clevis pins and for two fastening bolts at the center. Glue and nail in a 1/8" 3-ply web in each horn rib for stiff-



How the engine stringers are fastened to tubes.

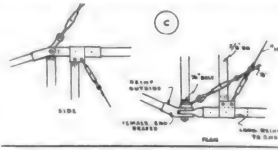
ness. Put in a filler block, of spruce, on each side where the horn goes. Bolt the horn to this point, with half above the hinge spar and half below. Attach a reenforcing block to the spacing stringer where it goes through the horn rib. Put in an 8-32 bolt with a pair of lugs, one top and one bottom, and run a 16 ga. hard wire from each lug to a horn tip for bracing.



How the rear tubing and spacer bars are made.

The rudder is made in the same way as an elevator. It has two hinges on the stern post of the fuselage (one near the horn), and two more at the tips of the two upper ribs of the rudder.

The entire fuselage structure can be finished in auto enamel, preferably black or grey. Three coats is best, being careful



How the turnbuckle anchorages are made at the front end of the fuselage where the engine supports are fastened.

to fill all joints so that rust will never start. Be particularly careful to heavily coat all wires and bolts. Every bolt must be locked either by riveting the ends a little to hold the nut, or by drilling it and putting in a cotter pin.

Wrap the longerons tightly with 1" binding tape from end to end. Tape with a herringbone weave is best. The method of wrapping should be the same as for a spiral bandage. Fasten the ends with a little wing dope. Wrap the struts C D on both sides of the fuselage, also the sternpost. See that the horizontal wood nail-strut is installed at D. Cut a panel of fabric for each side of the fuselage, with an inch overlap all around the edge. Sew it to the tape bound longerons, the strut CD, and the sternpost. Cut a panel large enough to cover the top of the fuselage, or the turtleback, depending upon whether a turtleback has been provided or not, with an inch overlap around the edges. Sew it to the top longerons, and tack it to the ends of the turtleback. Now tape all seams with 2" pinked edged tape, saturated with wing dope and brushed out smoothly at the edges.

The Heath-Henderson Motor

The back end of the Henderson "De Luxe" motorcycle motor becomes the "front" end in the airplane conversion. The flywheel cover is sawn off between the flywheel and the motor, and the flywheel is removed. The special crankshaft extension is riveted to the flywheel flange of the crankshaft with six 3/8" steel rivets. The extension is machined integral with the crankshaft in accordance with Fig. 8. A keyway is cut in the extension as shown, to accommodate a $\frac{1}{4}$"x$\frac{1}{4}$" key, and the end

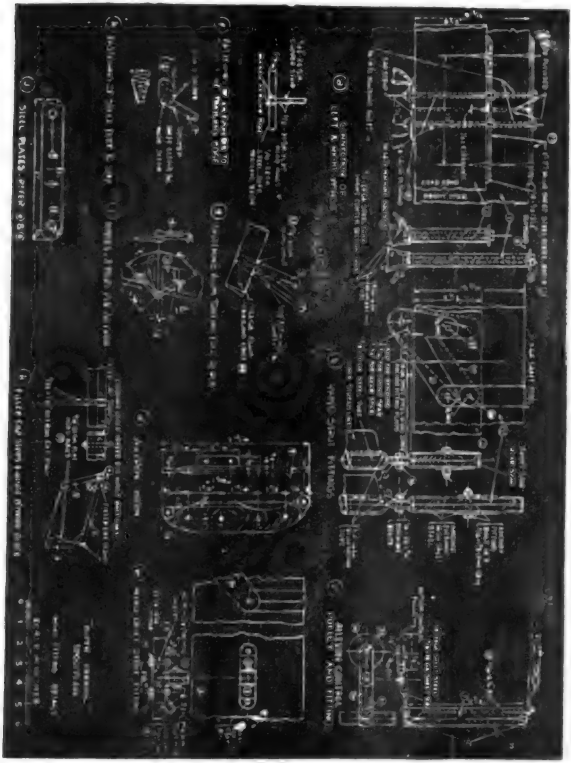
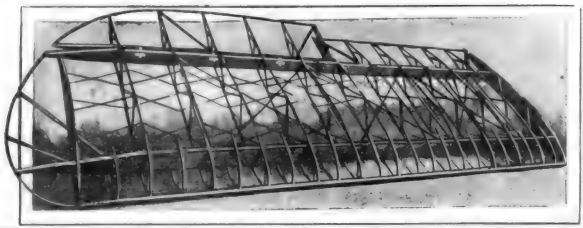


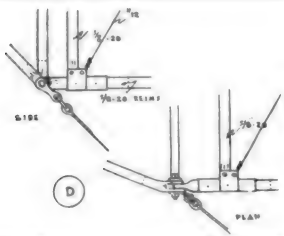
Fig. 3. Miscellaneous details.

is threaded for a 7/8"—18 S.A.E. nut. The end of the crankcase where it was sawn off must now be faced to a perfect plane, to make a seat for the cover plate which must also be machined with great care. The holes for the 1/4"—20 fillister screws which hold the end cover plate on the crankcase must be drilled with a 13/64" drill and tapped for 1/4"—20 fillister screws. The inside of the end cover plate is machined to hold a No. 305 thrust ball bearing in perfect alignment with the special crankshaft



This excellent view of an uncovered completed wing panel will give amateur lightplane builders a very good conception of the manner in which the wing is designed. Solid spars make for simplicity and strength.

extension. The special parts required for the conversion can be obtained from E. B. Heath. The machining must be done with great accuracy if the motor is to function properly, and it is probably best to send the motor to the Heath factory. 1727 Sedgwick St., Chicago, Ill., for this work, as they have special equipment for doing it. However, a good machinist can do it successfully.



The bottom corner lead-off to the axle from the engine anchorage. The manner of fastening the turnbuckle is indicated.

The only change necessary in the oiling system is the installation of closed type main and connecting rod bearings instead of the regular open type bearings. This should raise the oil pressure to nearly 100 lbs. instead of the usual 5 or 10 lbs.

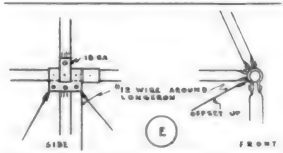
In the ignition system a slight advancement of the spark is necessary. The best adjustment of the spark is the one that gives the highest number of revolutions per minute with good running throughout the speed range of the motor. If a good job is done throughout, this motor should turn about 2,800 R.P.M. on the ground at full throttle, and 3,200 R.P.M. in flight.

The aluminum port plugs shown should be obtained and used. They carry the heat away from the cylinder head and radiate it, preventing warped valves, and adding many hours of service between overhauls.

Short exhaust stacks as shown must be provided. They present little difficulty; any welder can make them.

When complete, the motor is placed upon the engine bearers of the motor mounting. It is held in place by four $\frac{1}{4}$"x$2\frac{1}{4}$" S.A.E. cap screw bolts. These bolts must be carefully tightened and locked with cotter pins.

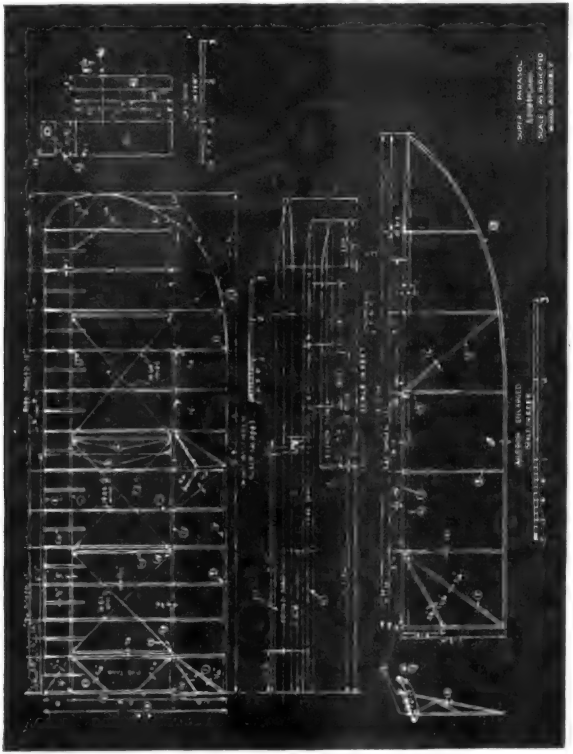
The tachometer, or revolution counter,



One of Ed Heath's simple weldless metal joints is explained by this drawing, which shows a typical strut station.

is connected to the end of the camshaft, using the Heath adapter. The flexible shaft is carried back directly to the tachometer mounted in the center of the instrument board.

The oil pressure gauge pipe is attached



The new high lift wings, around which the Super-Parasol has been designed, are simplicity in themselves. The spars are solid, and the wing is internally braced with No. 14 hard wire. The wing gas tank dimensions are also given.

as in motorcycle usage and carried straight back to the oil pressure gauge on the right side of the instrument board.

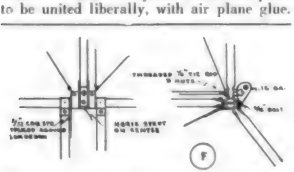
The propeller hub can be machined according to the drawings. Its cost is so low, however, that it is probably best to obtain it from the manufacturer.

The wings must be constructed with

great accuracy and of the best materials. It is first necessary to make a jig in which to assemble the wing ribs. Procure a perfectly smooth board 2"x8"x5' to serve as a base for the jig. On the smooth face of this board lay out neatly and accurately in pencil, the plan of the rib in full size, using double outlines, showing the top and bottom cap strips, the vertical strips in front and in rear of each beam, and the diagonal brace strips, or Warren truss. There are two styles of ribs as shown on page 62, common ribs and aileron type ribs. There are seven common ribs, four aileron type ribs, one modified aileron rib, and one special rib next to the wing tip, in each wing.

The easiest way to lay out the rib pattern is to obtain the full-size rib layout blue-print from the manufacturer, and then tack it to the base board. Now drive 6 penny nails, the heads of which have been clipped off, along all the outlines so that when 7/32"x7/32" spruce strips are shoved down between them, they lie upon the drawing exactly matching its curves and contours. Near the front of the rib the top cap strip has a rather abrupt downward bend which will break the wood if it is bent dry. If it is bent wet, the glue will not hold. The best method is to prepare the top cap strips on the preceding day by soaking them in boiling water, and then bending them to the approximate curve over three nails driven in a board. When perfectly dry they are ready for gluing and nailing into the ribs.

Fill in all the outlines of the rib jig with 7/32"x7/32" spruce strips cut to fit, until the entire rib is complete excepting fastenings. Wherever there is a joint, smear the parts to be united liberally, with air plane glue.



This shows how the landing gear struts are secured.

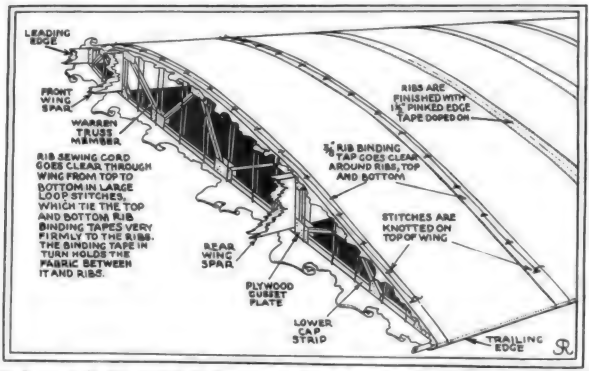
This splendid view of the finished cockpit of the Super-Parasol, with its simple but neat instrument board, gives a good idea of the compactness of the ship.

Now make about 884 gusset plates of 1/32" 3-ply plywood as shown, to make the joints. Each joint requires two gussets, one on each side of the rib. Smear the side of the rib where the gusset goes, and the gusset, with the airplane glue. Secure the gusset with a couple of 3/4"x21 ga. flat head wire nails driven into each member of the joint.

When gussets have been glued and nailed to all of the joints on one side of the rib, lift it carefully from the jig, turn it over on another smooth board, and glue and nail gussets to all the joints on the other side. All excess gusset material must now be cut away and the rib is complete. The inner rib of each wing instead of having gussets on both sides, has gussets on one side only, and a large sheet of 1/8"x61/2" x54" 3-ply plywood glued and nailed to the other side to make a solid butt rib on each wing. Trim off the excess plywood down to the cap strips to give the rib its correct contour.

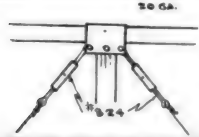
Preparing the Spars

The front and rear spars are made as shown on page 59. Their outer ends are tapered with saw and plane to the outline shown, and after extremely careful measurement 7/32" holes are bored in pairs along the center lines, for the bolts attaching the wing drift strut metal fittings to the spars, to pass through. The aileron spars are made of 1/4"x3 17/32" 6'3" spruce. They are tapered as shown in the blueprint



Mr. Rouse made this drawing to show exactly the steps to be taken in sewing on the wing covering. Dope is applied with an ordinary wide paint brush and is allowed to thoroughly dry before the next coat is applied.

and have two 3/16" holes bored 2'8 23-32" from the square end, for two 5/32" bolts to pass through to attach the aileron horn. Four internal wing drift struts of 5/8"x5/8" x2'5 5/16" spruce, are required for each wing.

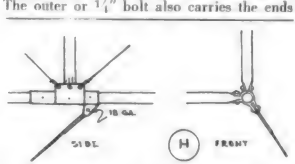


This shows how the undercarriage wires are clipped to the fuselage longerons with 18-gauge fittings.

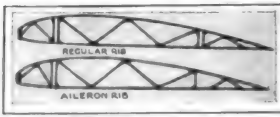
Preparing the Metal Fittings

The metal fittings should next be made. First make the connection parts for left and right wings, see fig. 4, a. For the front spars make two 1/4"x6½" machine bolts, for the rear two 1/4"x4⅝" machine bolts. These bolts pass down through holes drilled on the center line of the tops of their respective spars, and on top pass through a strap of 1"x7"x16" ga. sheet steel, and a 1/8"x5/8"x3½" plywood shim nailed and glued to each spar. At their bottom ends the bolts each pass through a 1/8"x5/8"x1¼" plywood shim on each spar and thence through the holes in the horizontal flattened portion, at the upper end of the wing supporting struts.

The wing strut fittings should be made as in fig. 4 b. Each consists of two anchor fitting plates, one bent strip bent over the top of the spar, a 3/16"x1½" bolt, and a 1/4"x1½" bolt. The anchor plates are cut from 16 ga. sheet steel, and are drilled for one 3/16" in one 1/4" bolt. The strap is made from 1"x16 ga. sheet steel. The anchor plates are placed, one on each side of the spar as shown, and the bolts pushed through the holes in them and the spars. The outer or 1/4" bolt also carries the ends



The 20-gauge pinned fitting holds both struts and buckles.



A regular rib has tab pieces with gusset plates on both sides of the spar. The ribs made up to be placed in way of the aileron are left open in the rear for the aileron spar.

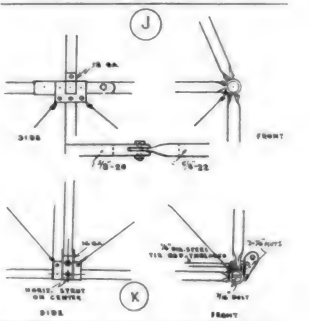
of the strap which bends over the top of the spar. The bottom lugs beneath the spar have slight double bends to bring them together against the flattened upper end of the wing strut.

The wing drift strut fittings are made as shown in fig. 4, c. Each consists of a 7/8"x3 1/4"x16 ga. sheet steel strap, bolted to the inner face of a wing spar, with its ends turned up a little to make jigs for the attachment of internal drift wires. On the other side of the spar the bolts are passed through the two holes of an oblong 5/8"x-2 1/8"x18 ga. sheet steel washer plate, to prevent the bolt heads from pulling into the wood. In the center of the strap is brazed and riveted, with one rivet, a 7/8"x2"x16 ga. sheet steel strap with its 5/8" ends bent up at right angles to the spar, to embrace the end of an internal wing drift strut, which is held in the step thus formed, by a 3/10" bolt passed through both lugs and the end of the strut. The outer wing end drift strut fittings and the inner wing end drift strut fittings need only one instead of two lugs.

Assembling the Wings

Assemble each wing individually. Take a front wing spar and a rear wing spar, and put pencil marks on them showing the exact position of each rib. Slip the ribs onto them, about as one would slip beads onto a pair of strings. Be sure and have the common, aileron, and plywood sided ribs in their correct places. Attach the wing drift strut fittings in their proper places and install the 5/8"x5/8"x2 5/16" drift struts. Block the wing up in a manner which will hold the drift struts and spars perfectly square, then make up a set of internal drift wires as shown, using No. 14 hard plated aircraft wire No. 324 short eye and fork turnbuckles, clevis and 5/32" clevis pins. Adjust these wires to hold the spars and struts square, then fasten the ribs in place with airplane glue and 1/2"x21 ga. flat head wire nails driven through the bottom capstrips, and through the vertical strips of the ribs, in front and rear of the spars. Do not drive any nails through the top cap strips, for they do not touch the spar properly for nailing. The last two ribs at the wing tip are different in contour from the rest because they are shorter. The second from the tip is a regular aileron rib left flat on the bottom, with the top cap strip bent down from the rear spar back, to join the bottom cap strip at a point somewhat forward of the regular trailing edge position, due to the forward curve of the trailing edge.

The leading edge is next installed. It is a piece of spruce 3/4"x1 7/8" in cross section. It is laid up against the small ver-



Instead of using welded joints, Heath has devised a system which is all-metal but which has none of the hazards of welding. It is a special plate fitting made in simple fashion of metal and pinned to the longeron.

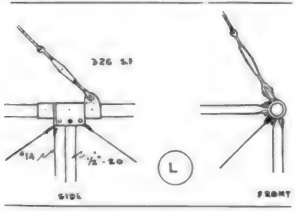
tical strips at the front ends of the ribs and fastened to them with 5/8"x21 ga. flat head wire nails driven through the vertical strips of the ribs into the leading edge piece.

It is best to install the false ribs at this stage. They are made of short pieces of 7/32"x1 1/2" spruce, boiled, formed and dried in the right curve in a small jig, and then attached to the leading edge and spar with

½"x21 ga. flat head wire nails and glue. Small recesses must be cut in the leading edge to receive their front ends.

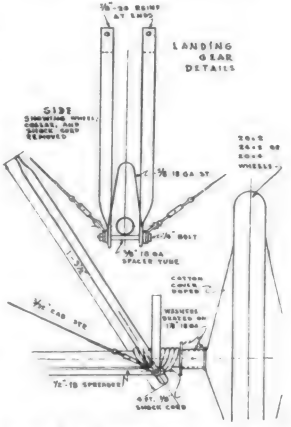
The trailing edge is next applied. From the wing butt to the inner end of the aileron, it is of channel section, 24 ga. sheet aluminum. The aileron trailing edge is 5/16"x22 ga. seamless steel tubing. The aluminum channel is 1" wide, as shown, and is easily applied by merely slipping it over the rear ends of the ribs, and fastening it with two ⅜"x21 ga. flat head wire nails, above and below. The tubing trailing edge of the ailerons is fastened in shallow notches at the near ends of the aileron ribs, with 1/32"x24 ga. copper strips nailed to the cap strips of the ribs with ¾"x21 ga. flat head wire nails, and soldered to the tube, see fig. 4, f. The tube trailing edge is attached to the aileron spar as in fig. 1, h, with a 24 ga. copper strap, bent around the tube and nailed to the spar, and a wood screw driven through strap and tube into the end of the spar.

The wing tip of 3/16"x22 ga. steel tubing, bent as shown, should now be attached. Its front end is flattened and drilled for three wood screws and it is attached with these to the leading edge, and further bound to it with a serving of 24 ga. strip sheet copper and soldered. It is attached to the spars as described above for the aileron trailing edges attachment to the aileron spar.



This shows the way the wing guy wires for the center panel joints are made fast to the longerons.

Slip the aileron spars into their places, and fasten them with nails and glue to the aileron rib cap strips. Fasten filler strips of cap strip material along the tops and bottoms of aileron spar and rear spar, in order that the ribs will not show as lumps along these edges when the fabric wing covering is applied.



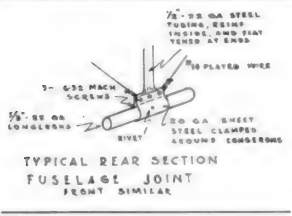
Details of the landing gear, front and side views. Heath can supply 18x3-inch wheels for use by those who have wet fields to work from.

Put ⅛" plywood shims on the top and bottom of the inner end of each wing spar, as in the description of the connection of left and right wings, see fig. 4, a. Fasten these plywood shims to their spars with nails and glue.

Next install the internal wood bracing. This is principally ¾"x¾" spruce sticks and is attached as shown.

The aileron horn should present little difficulty. It is cut out of 16 ga. 2"x9" sheet steel as shown in fig. 4, a. It is attached to the aileron spar by two 3/32" bolts passed through the holes already drilled through the spar. A washer is brazed on each side of its tips to make good bearings for the aileron control cable clevis pins, and it is reenforced by a piece

of 1/8" plywood on each side, held by 1/8" bolts passing clear through the horn. There are three hinges per aileron. They consist of 1/4" eyebolts with their eyes laid together and clevis pins passed through them.

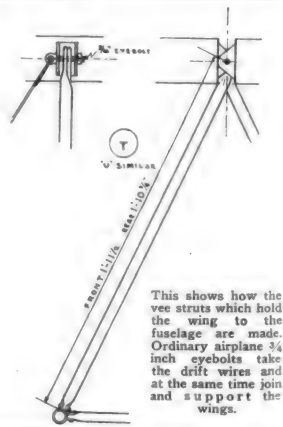


This gives a clear conception of the manner in which the special Heath fitting is made.

These eyebolts must be so installed as to take thrust both ways when in use. Install them as shown in fig. 1 and fig. 4, i and k, attaching small triangular cross sectioned spruce blocks to the spars, to serve as shoulders for the nuts of the eyebolts. When this has been done, saw off all the cap strips between the aileron spar and the rear spar and the aileron will be swinging on its own hinges. At this stage the wing should appear as in fig. 5. The diagonal bracing seen between the ribs in fig. 5, should be installed at this point. It consists of heavy Irish linen cord, attached as shown and heavily coated with wing dope to tighten and strengthen it.

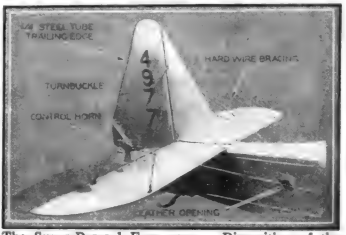
Aileron control pulleys and the fittings to attach them to the front wing spar (see fig. 4, C.) must be made very precisely, as it is necessary that they do not bind in any way. The straps for the pulley sheaves are made of 5/8"x20 ga. sheet steel and require only a slight double bend in forming. Pulley axles are 3/16"x5/8" clevis pins. Each pulley requires a shackle strap of 5/8"x18 ga. sheet steel with a double bend, to hold it away from the surface of the wing, and to attach it to the 5/8"x18 ga. double bent strap that goes around the front face of the front wing spar. The entire assembly is held together by a 3/16"x6 1/4" bolt lying against the rear face of the spar as shown. and two wood screws driven through the strap, one into the top and one into the bottom of the spar.

Fifty feet of 1/8" extra flexible control cable is required for the aileron control system. The top horns of the ailerons are connected by a cable with a No. 324 long double-eyed turnbuckle in its center. The cable has ends made as described in the preceding installment of this article. It is attached to the horns with clevis having 3/16" clevis pins. The cable passes directly forward, through the pulley on top of the front wing spar and thence along the top of the wing above the front wing spar, until it reaches the upper aileron pulley on the other wing, through which it passes back to the top horn of the other aileron. This links the ailerons so that when one is pulled down the other must always be up. This cable should have a small leather guide or fair lead near its center to prevent its slapping around in the wind. This guide may be made of a piece of 3/4" leather strap bent double around the cable and secured to the front wing spar with two wood screws through a two-holed washer plate. A little grease should be applied to this leather loop. Its function is about the



This shows how the vee struts which hold the wing to the fuselage are made. Ordinary airplane 3/4 inch eyebolts take the drift wires and at the same time join and support the wings.

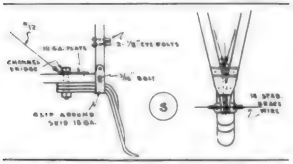
same as that of the guides on a fishing rod. It should hold the cable very loosely. Two cables are made up for the bottom horns of the ailerons. Each is attached to the lower tip of an aileron horn with a clevis, and then passed forward through the pulley on the bottom of the wing just below the front wing spar, and then towards the fuselage, in a straight line from the pulley to the tip of the vertical horn on the torque tube of the stick control in the fuselage, where it ends in a No. 324, long double-eyed turnbuckle attached to the horn.



The Super-Parasol Empennage. Disposition of the turnbuckles, hard wire bracing, tailskid and stabilizing fin is plain to be seen. Note leather to protect cloth covering.

Gasoline Tank

The gasoline tank is constructed as shown in fig. 3. It is made of 24 ga. sheet steel. The brand known as Long-Tern is satisfactory. It is made in two pieces, one of which is bent to form the sides and bottom and another to form the ends and top. It is equipped with a filler neck and cap on its upper surface at the front end. A Ford radiator cap and filler neck may be used. The outlet is located on the bottom of the tank at the rear. The outlet is connected



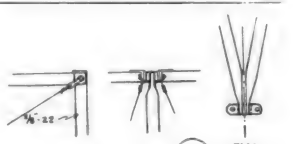
Detail S, taken from the large drawing in Fig. 4 (Jan.) shows how the tail skid is constructed.

to the carburetor by 5 ft. of 1/4" copper tubing. This tubing should have some spirals bent in it at each end to deaden vibration which might crack the tubing. Just below the outlet of the tank and in reach of the pilot is located a 1/4" shut-off cock. The tank described will hold about 11½ gallons, and gives the ship a range of about 210 miles at around top speed. If more range is required install two identical tanks, one in each wing. As the space in the wing butts occupied by the tanks is not stiffened by internal drift wires, it is necessary to stiffen the structure with a Warren truss of 5/16" square wooden sticks above and below the tank as shown in fig. 3. The truss shown in fig. 3 would be greatly improved, however, if the ends of the 5/16" square sticks came together on the solid butt rib. This reenforcement is important and must be well done. The bay holding the wing tank is the weak point of many ships.

Making the Wing Struts

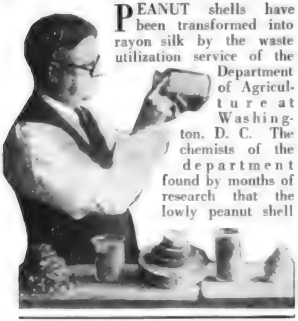
The trick of getting the wing struts right lies in making them of correct length. Due to the fact that the wing is set at 2 degrees to the horizontal front end of the bottom longeron, when the plane is in flying position, that is, flying level, it is necessary to make the rear wing struts slightly shorter than the front struts. To find just how much shorter, it is best to install the wings on the fuselage, blocking up the fuselage in flying position, and blocking up the wings correctly in relation to the fuselage by means of a pair of tall saw horses or some ropes from the ceiling. Now it is

(*Continued on page 184*)



This shows how the sternpost and the fittings at the tail of the fuselage are constructed.

Synthetic Silk is Produced from Peanut Shells



Dr. S. J. Lynch is seen above with a pile of vegetable materials from which synthetic silk is made.

PEANUT shells have been transformed into rayon silk by the waste utilization service of the Department of Agriculture at Washington, D. C. The chemists of the department found by months of research that the lowly peanut shell could be chemically treated to produce the basic material of rayon, from which the rayon silk garment is made.

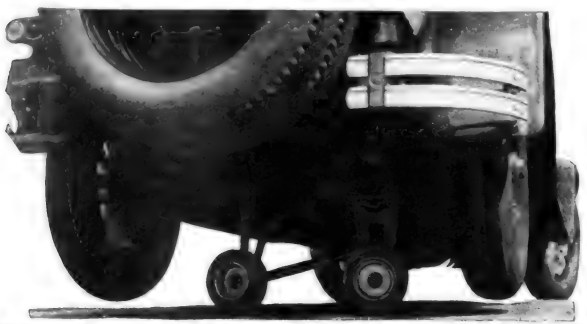
The work done by the waste utilization service is of great value to industry because it enables waste materials which would otherwise be thrown away to be utilized in the manufacture of useful products.

$7,500,000 A YEAR SPENT FOR MATERIALS

STATISTICS furnished by the purchasing agent of the Case Threshing Machine Company show the amount of money that is spent each year by a large corporation for materials. The company spends about $25,000 a day, or $7,500,000 a year on the basis of 300 working days, for materials that are used in the manufacture of its machines. It buys each year about 25,000 different items on 20,000 purchase orders.

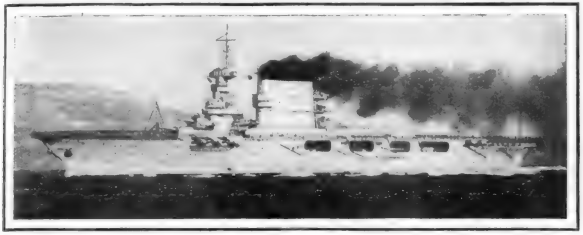
NEW INVENTION MAKES CURB PARKING EASY

CLINTON WALKER and his son, Bruce of Piedmont, Calif., have invented a device that permits a car to be parked in a space no greater than its own length. Two wheels about eight inches in diameter are suspended between and at right angles to the rear wheels of the car. These wheels are driven by two shafts which connect with an auxiliary attachment on the transmission. A special lever lowers the small wheels until they have raised the rear axle from the ground. The power is applied, the front wheels banked in and the car is quickly parked.



Power from the engine is applied to the auxiliary wheels shown supporting the rear of the car, and they move the rear wheels sideways into the curb. The front wheels are then banked in and the car is parked.

New Naval Aircraft Carrier Passes Its Final Test



PLUNGING over the Navy's official trial course at approximately 40 miles an hour, the *U. S. S. Lexington*, new $45,000,000 aircraft carrier, marked herself as one of the fastest large boats afloat. This speed run was part of the Navy's official acceptance tests which were conducted off Point Vincente, California. After the tests are completed this massive fighting monster will formally be admitted as a part of the United States sea forces.

The *Lexington* is driven by powerful electric motors. Huge steam-turbine generators fed by oil burning boilers develop current sufficient to light New York City and Brooklyn if it were directed to that purpose. This tremendous power reserve gives the *Lexington* the high speed capacity that an airplane carrier requires.

FIRST X-RAY MOTION PICTURE FILM PERFECTED

WITH a new X-ray motion picture film 200 feet long, A. C. Pillsbury of Berkeley, California, was able to picture the inside of a rosebud as it burst into bloom. The negative was exposed 800 times in 72 hours. The rose was placed in front of the camera, the X-ray shot through it at five minute intervals for 72 hours, and the world had its first X-ray motion picture.

The possibilities of the X-ray motion picture film are almost undreamed of. Many of the intricate processes of plant life have been a mystery to botanists for centuries. With the perfection of X-ray films many of these secrets will be exposed to science.

A. C. Pillsbury examining the first X-ray motion picture film, which was perfected recently in Berkeley, California.

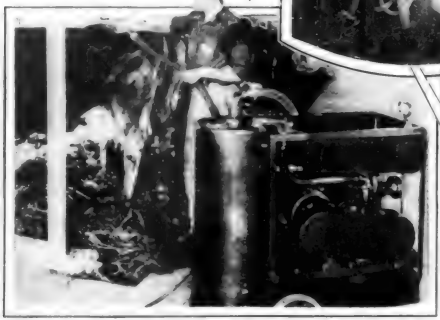
NEW AIRPLANE BEACON

LANGLEY FIELD, Va., will soon have a 1,500,000-3,000,000 candlepower revolving beacon. The new light will be mounted on the top of a 135-foot water tank located beside the field.

The beacon is visible to airplane pilots from a distance of about 60 miles and its strength is such that ocean-going vessels have been notified not to confuse it with the navigation lights of other vessels.

ELECTRICITY

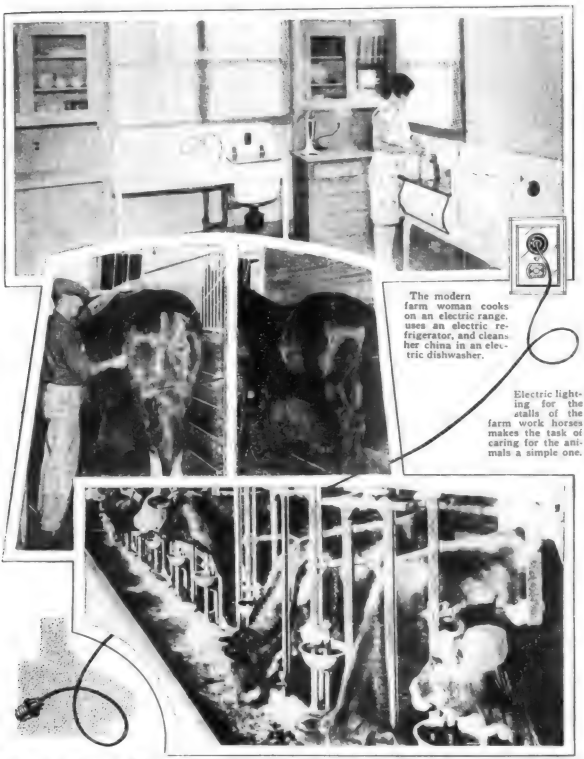
Above is a general view of the model electric farm at Mundelein, Ill., where everything from milking machines to vacuum cleaners for grooming the cows may be found. Just how simplified the farm chores have become may be understood by studying the picture at the right, where the attendant is adjusting an electric milking machine.



This portable electric vacuum cleaner simplifies the task of keeping the farm animals well groomed. The hired man comes to work in white linen, as shown by the photo in the inset.

Comes to the FARM

In this model electrified farm the hired man does the chores by simply pressing a button!



The modern farm woman cooks on an electric range, uses an electric refrigerator, and cleans her china in an electric dishwasher.

Electric lighting for the stalls of the farm work horses makes the task of caring for the animals a simple one.

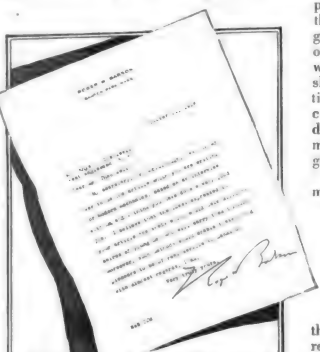
Each cow has her individual drinking cup, made possible by electric water pumping. Electric lights make sure that "bossy" will not suffer from eyestrain, and electric ventilators insure a constant supply of clean, fresh air for the dairy animals.

Roger W. Babson TELLS SEVENTY WAYS to

An Interview with RHYS G. THACKWELL

SEVENTY "big opportunities" for persons who are interested in Modern Mechanics and Inventions to become millionaires, merely by perfecting certain time and labor-saving machinery that is needed or by discovering solutions of various problems that now perplex men of science, were revealed to me recently by Roger W. Babson. America's outstanding business statistician, founder of Babson Institute and whose predictions of fluctuations in the business cycle are regarded with a profound respect by the nation's industrial leaders.

For the young men and women of today who are interested in radio, airplanes and various other inventions and developments Mr. Babson sees a field of endeavor that is today greater than ever.



Letter written by Mr. Babson endorsing this article by Rhys G. Thackwell, who was personal aide to Herbert Hoover during the war.

The opportunities to become a millionaire which Mr. Babson enumerated are: Volcanic power stations; Earth's rotation as a source of energy; cold light; automatic street cars; traffic signals that work from the driver's horn; 500 mile an hour airplanes; airplanes with sleeping compartments in the wings; cities' streets without any crossings; double deck streets; parking places on the first floor of stores; watches run by radio; books that talk; practical eugenics; medicine droppers taking the place of shovels; electricity made at the mines, making unnecessary the shipping of coal; the regulation of sex, height and other physical characteristics by electric waves; self-finding golf balls; automatic chemical analyses; automatic translators of languages; elimination of common colds; precast tunnels; synthetic foods; using gunpowder to put out fires; motor cars with gas turbines; sleeping accommodations on motor coaches; seawater dynamos; electric music; automatic garages.

Progress will be made in harnessing electrons and atoms; iceless refrigerator cars; telephones by which you can see; harnessing the tides; the wonders of the ultra violet rays; return to Sunday observance; utilizing the power of prayer; lights that pierce fogs; paper made of glass (glass which will not break we already have); long distance weather forecasting, including the prediction of earthquakes; telegraphing photographs; changing birch into mahogany; bringing about international peace; locating oil and minerals automatically; stabilization of the fishing industry.

Returning to the use of windmills for power; changing plant life; developing a mechanical man (the Televox is a step in this direction); cooling houses in summer as well as heating them in winter; gliders for every boy; music from the ether; the renumbering of cities; automobiles without

Everybody wants to become a millionaire—and now Roger Babson, America's great industrial leader, tells just how to do it! Any one of the ideas he explains below will net a fortune for the man who perfects them.

BECOME A MILLIONAIRE

gears; transparent metal; using the cosmic rays; new methods of preserving; new sources of gasoline; harnessing parasites; radios in the churches; selling lumber in packages; eliminating the need for dentists; farming under paper; real talking movies; counting with a weighing machine; planting by wind; houses without windows; fountain pens that write in three colors; feeding plants with pills; elimination of rust and decomposition; electric traffic officers; power from cornstalks, and the wonders of the new electric waves.

Vast progress has already been accomplished in achieving some of these goals, but their ultimate perfection and contribution to mankind to promote happiness and decrease physical toil will bring rich rewards to the pioneers, in the opinion of Mr. Babson. And Mr. Babson is a man whose opinion in such matters is eagerly sought by the men whose enterprise and industry has made it possible for United States, with only seven per cent of the land and six per cent of the population of the world, to produce over 50 per cent of the grains and basic raw materials.

One man can now take the seed from as much cotton as would have required the labor of 28,000 men without the cotton gin, and he can make as much yarn as would have been produced by 45,000 women on the hand-wheels of Colonial days. Mechanical power has been increased until it is equivalent to the work of three billion additional employes in our industries, or more than 350 helpers to each wage earner.

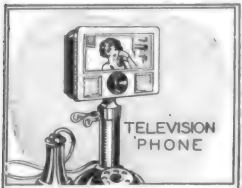
ROGER W. BABSON
Founder of the Babson Institute, America's foremost economist and the man whose predictions of future trends in the business cycle are eagerly studied by the nation's industrial leaders.

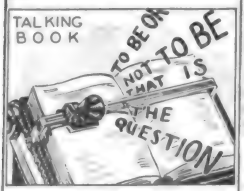
Mr. Babson commented further upon the possibilities of development of labor-saving machinery as a force to revolutionize not only the heavy or manual labor but also all kinds of mental labor.

"In statistical work, for example, we are turning more completely to mechanical computation, and my engineers are continually devising new machines and methods to save figuring," he pointed out. "I foresee some remarkable developments along this line. Technical problems until recently beyond the power of unaided human brain to solve, will be handled with ease by some computing mechanism of the future. We have just begun to realize the possibilities of the 'brain-in-a-box'."

In the near future Mr. Babson sees airplanes in great numbers, though not as common as automobiles, he said.

"These airplanes of the future will either be constructed on some principle equivalent to the helicopeter—or they will not be constructed at all, in any great quantity. In other words, to come into general use the airplane must be able to rise straight up and to descend straight down, on a small spot. To decide this question in your own mind, ask yourself whether you would today own an automobile if you had to begin and end each trip in a distant auto-port?

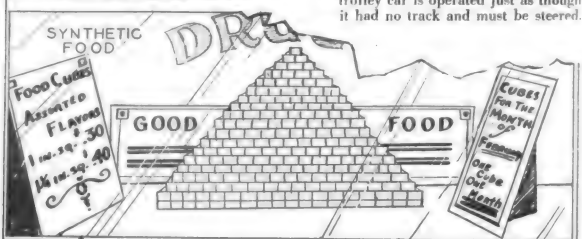




"As to the automobile, it is not impossible that the cars of the future will be designed to run sidewise as well as forward and backward. The more intense parking problems of the future will put a premium upon the ability of a car to maneuver. That this crab-like motion for an automobile is not altogether an impossible idea mechanically is suggested by the diagonal motion which you will notice in the self-propelled baggage trucks that weave their way around railroad stations and also in the similar trucks which are being used in factories. Growing congestion during the next 25 years will also encourage the development of elevated streets or sidewalks and elevated crossings."

Mr. Babson pointed out the possibilities of a horizontal elevator.

"Anybody who has watched the smooth way in which elevator traffic is handled in a big modern office building must have wondered why similar methods could not be used for horizontal as well as vertical transportation," Mr. Babson said. "Imagine the tumult, confusion and delays if it were as bothersome to get to the top floors of an office building as it is to travel an equivalent distance by trolley car along the city streets. There seems to be no reason why elevators could not be arranged to run back and forth as well as up and down. This, of course, immediately suggests whether such transportation could not be arranged to be operated in a semi-automatic way by the passengers themselves just as we now have passenger control for electric elevators. I anticipate the day when radical changes may be made in trolley car transportation in the congested areas. Although such cars are now steered by the track, no advantage is taken of this. To all intents and purposes, the trolley car is operated just as though it had no track and must be steered.



Millions of dollars await the man who invents and commercializes the devices pictured in the drawings above. Fireproof paper for important treaties and documents, talking books for those who cannot read, food cubes and the television phone—all will sooner or later be perfected by human ingenuity.

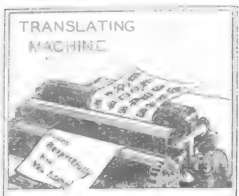
"One of the most radical of future developments caused by the parking problem will be the more intelligent use of the parking facilities already provided by streets where traffic is relatively light. According to certain legal precedents and also everyday justice, it would seem that if parking is to be permitted on a street at all, then the rights to such parking should be at the disposal of the property owners and tax payers. This means that a property owner and tax payer in a street where parking is permitted should be able to lease the parking privileges in front of his property.

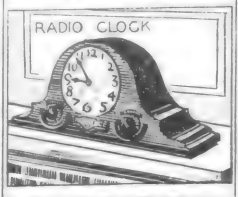
"There will be continued developments of electric cooking and gas heating. Along with the gas heating of homes there will naturally be an improvement of insulation against heat and cold. One of the most important and most common of economic wastes at present is that caused by such ineffective insulation of our homes. What we are really doing in many cases is to heat all outdoors.

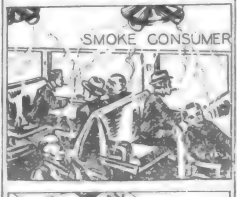
"Radio in the future, of course, will include television and such broadcasting may still further crowd the air. I look for the greatest development in connection with wired broadcasting whereby those who wish to avoid the crowd, so to speak, may receive their programs, both audible and visual, over the wires of the electric light or the telephone system. This will also make it possible for those who wish to pay a small price for radio programs to dictate the character of such programs.

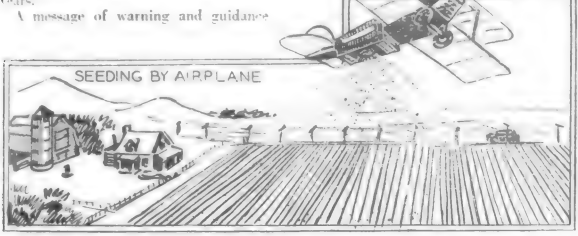
"There will be innumerable inventions for making daily life more effective. For instance, the clocks of the future will not only be wound by electricity, but will be electrically controlled. This is but one example of almost countless devices which might be mentioned among the things that will be commonplace before many years."

A message of warning and guidance









Can you imagine how helpful a translating machine would be in changing Chinese and other languages into English? The man who invents such a machine, as suggested by Mr. Babson, will reap a fortune in selling his device to importers and scholars who must translate many foreign tongues. Perfect any one of the machines pictured above and make your million!

Pancake Baker!

The inventor of this machine, which turns out 400 pancakes an hour, is well on his way to becoming a millionaire.

which can be kept really sharp; a cheap and simple device to prevent glass stoppers from coming out of bottles when traveling; an electrically driven bicycle; a photographic negative that can be developed in daylight; a device to consume and absorb tobacco smoke; an improved method for cleaning large plate glass windows; a pneumatic tire that cannot be punctured; a chemical process for rendering paper fireproof to be used for important documents; an oven in which opening the door automatically withdraws the contents, thus preventing possibility of burning hands; a pencil that marks as black as ink; a new paper bag for confectioners to eliminate blowing into the bag to open it, thus spreading germs perhaps; a way to convert sound into energy; an anti-fog spray to be used from lamp-posts; a new gas that could be pumped like water, harmless to anything save fire and which could be used to put out fires and thus save damage that otherwise would have been done by water; a horse shoe with which the animal can keep his feet on smooth-surface roads in any weather; some way to withdraw dust from the air; secret wireless telegraphy; a camera that works in the dark; a silent lawn mower; ink that dries instantly.

for young people who are approaching the period when these marvels of science will have been achieved was offered by Mr. Babson.

"With these opportunities there will be certain dangers," he pointed out. "The chief peril against which we must guard is a letdown on the moral and spiritual side. Twenty years from today people will be dealing with powers far in excess of anything we know today. Unless we have a proportionate development of intelligence, integrity and other elements of character, I can clearly foresee catastrophe on a gigantic scale."

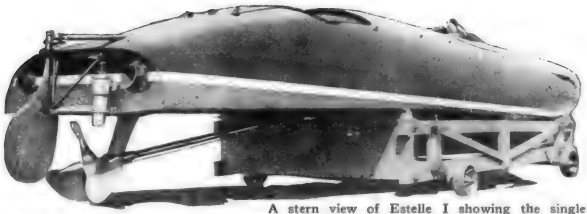
Though not predicting that their accomplishment would make the inventor a millionaire, the Institute of Patentees, a mutual aid organization for inventors in London, England, has just issued a list of 339 ideas and needs, selected from thousands that have been proposed to it as requiring solution. Some of these ideas were suggested by Mr. Babson, too.

Among needed inventions that were suggested are: a motor engine that does not require decarbonizing; a safety razor blade

More inspiration for those who want to become millionaires by inventing things that Mr. Babson has said will make them wealthy is to be obtained by reviewing a portion of the epilogue to this summarization of new ideas issued in London. Professor A. M. Low, a British scientist, wrote, in part: "There are two main directions along which the march of invention proceeds — toward speed and toward comfort. Up to now nearly every important invention has lain in the speeding up of an existing process, but at last we are beginning to realize that the gallop of today is sometimes temporarily less comfortable than the leisurely canter of the 'good old times.'

"Transport provides an excellent example. Even air travel is extremely uncomfortable. There are pitchings, tossings and irritant sound vibrations which are unpleasant and even dangerous to our ears and body. On the ground it is almost as bad. The jolts and jars of buses and electric trams and the nerve-shattering noises which they make are a menace to health."

Inventions of comfort have not kept pace with those of speed. Perhaps this is the field in which to make *your* million!



A stern view of Estelle I showing the single armed propeller strut and the "outboard" rudder mounting.

AIRPLANE PRACTICE in Boat Design

OWNED by Miss Betty Carstairs, English sportswoman, *Estelle I* is the latest embodiment of the streamline idea in the design of fast boats. Every detail has been planned not only from the standpoint of cleanness in naval architecture, but also with an eye to the aerodynamic efficiency of that portion of the hull which is above water and which formerly was considered of little importance in the attainment of extreme speed.

The hull was built by the famous British builder, Saunders of Cowes. Saunders uses the famous material "Consuta," which is a plywood sewn together with stout copper wire. It can be steamed and molded like rubber composition. Indeed, the hull for *Estelle I* was built upon a mold conforming to the lines the naval architect had planned so that the beautiful curves of her hull could be obtained with the use of this material.

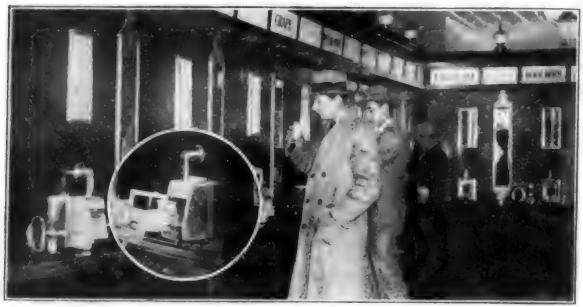
Below the water line her design is equally interesting. There is the traditional step in the bottom by which a large portion of the wetted surface of the hull is cut out automatically when the boat gets to planing.

The single armed strut for supporting the propeller shaft is considered excellent design practice, as is also the rudder mounted with all connections outside the hull, or "outboard," as yachtsmen term it. Formerly it was thought that a bow rudder was the best for speed boats.

Estelle I, with her streamlined hull, her liter and a half (91.5 cu. in.) motor which develops well over 150 h. p., and her rod-controlled rudder, is considered the acme of British speedboat design. Note the pipe at the stern. When in operation the valve is opened and the bilgewater is sucked out automatically!

Miss Betty Carstairs rides in her new speed boat as it is being hauled to the beach.

Automatic Soda Fountain Eliminates Waitresses

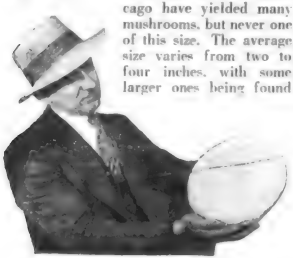


NEW YORK has the newest idea in soft drink parlors—the Sodamat, at 55th and Broadway. As the photo above shows, it has all the flavors that could be desired by a thirsty patron. The busy New Yorker need not pause for waiter service. He can step up to the vendor containing his favorite drink, place the proper coin in the slot and have the cooling liquid before him.

The insert shows a patron reaching into the vendor for a drink that he has just purchased. This type of mechanical food and drink dispenser is becoming popular throughout the east. The rush and hurry of our larger cities make it extremely difficult for customers to get service. Therefore the ingenious American mind has developed the automatic vending machine.

GIANT PUFFBALL MUSHROOM IS FOUND NEAR CHICAGO

RECENTLY a toadstool picker came upon a puffball mushroom that measured 30½ inches across. The woods near Chicago have yielded many mushrooms, but never one of this size. The average size varies from two to four inches, with some larger ones being found occasionally. How this monster grew to these proportions without being discovered is a mystery best explained by the fact that mushrooms grow with great rapidity when the surroundings are ideal.



Above is the thirty and one-half inch mushroom held by Bill Shaw of Chicago.

NEW AIR RECORD SET!

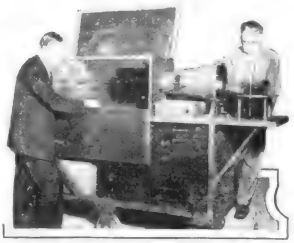
EDDIE MIDDAGH established a new west bound record for mail planes between Chicago and Minneapolis when he flew the route with five passengers, mail, and pictures of the ill-fated liner *Vestris* in two hours and 42 minutes. This time was one hour and 28 minutes faster than the regular schedule between these two cities.

The Northwest Airways were anxious to get the valuable news pictures of the *Vestris* disaster to Minneapolis as soon as possible. They gave Middagh the pictures and told him to get them there in a hurry. He did!

New Camera Takes Pictures in Fractions of Seconds

STUDENTS of electricity at the California Institute of Technology will be able to study electrons and the displays of other electrical phenomena with the aid of a new camera which is sensitive enough to record movement at the one-hundred-millionth part of a second. The machine is called the cold cathode ray oscillograph and can record by picture action 100,000 times faster than the fastest camera.

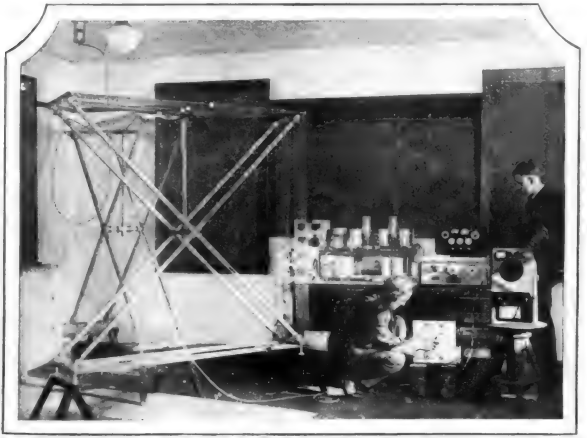
Prof. Royal W. Sorenson, head of the Institute's electrical engineering department, and Charles G. Lauritsen of the faculty, shown in the photo, declared the new speed camera to be the best piece of equipment that has ever been purchased by the electrical department of the school.



STORM PREDICTING DEVICE INSTALLED BY NAVY

USING a large loop antenna to determine the direction from which static signals are received, this new static recording device makes a graphic record which is used by the weather department to predict storms. The strength of the static signal tells the meteorologists the general path that the approaching storm is taking.

News of approaching storms is given to all parts of the United States so that owners of products effected by temperature changes, may take protective precautions.



Lieut. Eldridge, Aerological officer of the U. S. Navy, is seen above operating the new automatic static recording device that has been installed in the Washington Air Service with which to make storm predictions.

Outboard Motor Boat Breaks Speed Record

COVERING five miles in eight minutes, ten seconds, this "Blue Streak" speed boat won the Class C 5-mile outboard motorboat race at Lake Elsinore, Calif. H. G. Ferguson piloted the boat over the course at an average speed of 37.004 miles an hour. This time broke the world's record for a boat of this type.

The "Blue Streak" is a beautifully designed one-step hydroplane. Lightness is evident in every portion of the hull. There is very little freeboard to weigh down or offer wind resistance. The raised cowl deck is designed to break the wind before the pilot's face, thereby decreasing the wind resistance from his body.

The motor is a standard make with several refinements that give it more speed. Note the oil cups mounted above the flywheel and the tube connected with the carburetor, which tends to scoop in the air and compress it.

ROTOR MOTOR DRIVES PUMP

SIMPLICITY of construction and low cost are the strong features of this rotor motor water pump that is to be found near Berlin, Germany. The rotor principle of transmitting wind pressure through a cylinder, as used by Flettner on his famous ships, has been applied to a pump with very satisfactory results. The pump is capable of lifting 11,000 gallons a day with a normal wind. Wind direction is of very little consequence to the rotor motor because it will operate without having to change its face into the breeze, as does the ordinary windmill. The rotor pump is thus enabled to keep on the job without any time out in waiting for favorable winds.

OLD CAR ON WORLD TOUR

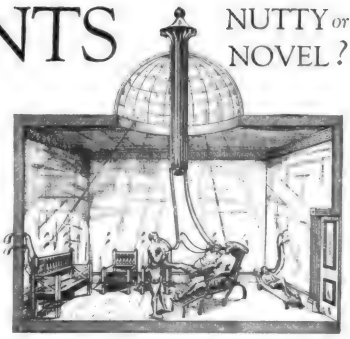
"AROUND the world or bust," is the motto of two Italian motorists, Signors Gaudenzio and Elio, as they rattle along the roads of Europe in their "Antediluvian" motor. This side-winder of 1904 vintage should really be in a museum, but the boys declare that they will make world circuit no matter how steep the grade.

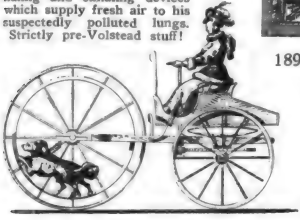
The car lacks most of the conveniences that our modern vehicles possess.

PATENTS NUTTY *or* NOVEL *?*

GAS MASKS FOR THE TURKISH BATH

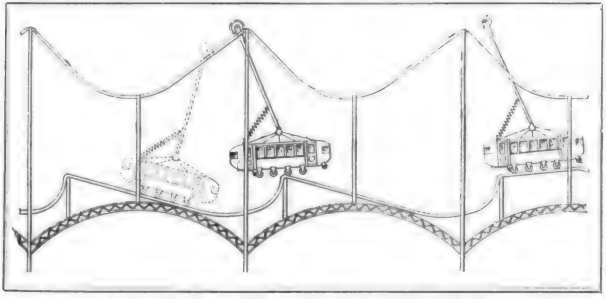
With his pulse freshened by the rigors of a Turkish bath, some inventor of another day swore off liquor so fervently that he invented a device for relieving these headache emporiums of any suggestion of odoriferous breaths. The result resembles a cross between a modern Navy decompression chamber and a wholesale pulmotor ward. Each cleanly soul is fitted with inhaling and exhaling devices which supply fresh air to his suspectedly polluted lungs. Strictly pre-Volstead stuff!





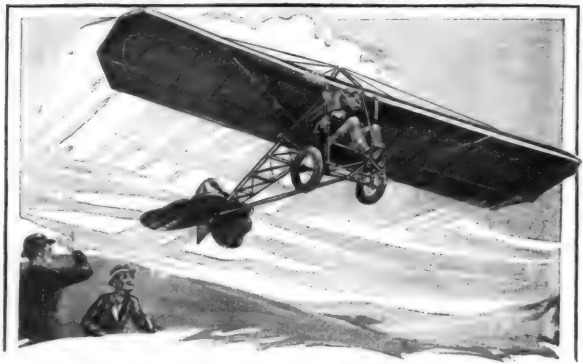
1890 DOG-POWER AUTOMOBILE

"Sic 'em," is the starting signal with this hosaless carriage! Long before the day of the modern auto a New Yorker invented "certain new and useful" improvements in the manner of going places and doing things. The result is shown at the left. Great things for funerals they were, it is said, but since viewing the patent specification we've had a pet hunch that a hook and ladder fire engine could be cooked up which would go like ringtailed rannyhans.



PERPETUAL MOTION FOR STREET CARS

This lunch-ejecting, bump-detecting trolley for tired men hits a bump and takes a jump and slides down hill again. The big idea uses gravitee and saves on power bills. It's not so good for no one could survive the thrills and ills. And furthermore from what we hear the thing would never work. Friction Loss would soon be boss and stop it with a jerk. Heh! Heh! That didn't prevent the Patent Office from making a mistake and granting a patent on this perpetual motion street car!



An Easy-to-build GLIDER

by CARL H. DUEDE

Powerless flight is one of the most practical ways for young men to learn the traits of the air. Mr. Duede gives concise instructions for building his latest glider.

HAVE you ever watched a prairie gull soar for hours on end without moving a wing? Their secret is the use of rising currents of air for the sustaining of flight. Men who build gliders in which to make powerless flights use the same principle, and to do this they must have a light machine.

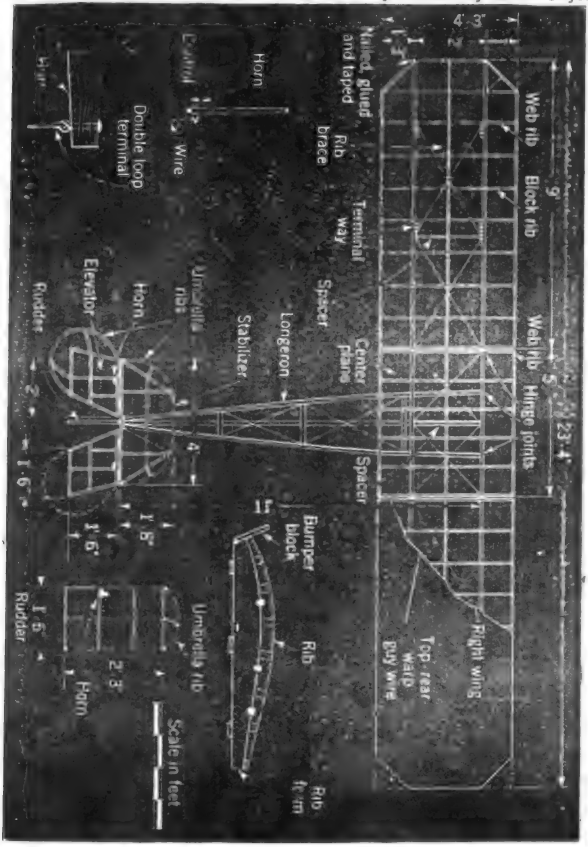
This machine I am about to describe is one which is very light and simple and can be built with the materials at hand in the lumber yard of your home town.

It is a small ship. Its wing spread is but little over 23 feet, and the length is but a few inches over 14 feet. The chord of the wings is 4 ft. 3 ins., and the wing is built up in three panels. The center panel is five feet wide, the left and right wings are nine feet wide, the wing spars are two feet apart. All wing ribs are spaced a foot apart, which gives an ample safety factor. There are all told 18 block ribs and 6 solid ribs and 3 spacers.

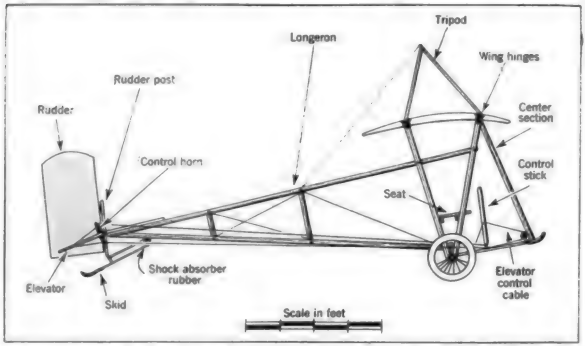
For the wing ribs secure a board as straight grained as possible and ½-inch thick. This should be ten or twelve inches wide. It should be 14 to 16 feet long. Rip up some of the wing rib battens which are used in the construction of the wing ribs for upper and lower edges.

Rip these to a size so that when they are planed to smoothness they will be ⅛-inch thick. Cut them to a length of 4 ft. 6 ins.

Next a rib form should be made which will be like the drawing of the rib form in the blueprint. Lay the batten on this curve which is cut into the board. The curve should have about 2 inches camber a little less than a third of the way back. Lay the batten with small brads in each end to hold it. The blocks which are placed on the battens are of the same wood as the battens. When planed to size they should conform to the curve of the rib, being about 1⅝-inches wide, $\frac{5}{16}$ of an inch thick and of depth to conform with the wing rib. Place six



Details for the framing of the Duede glider are here graphically shown. Methods of making the control horns, the rudder, and the form on which the wing ribs are to be made can be seen from this blueprint which is drawn to scale.



This drawing shows the profile view of Mr. Duede's light glider which weighs barely more than sixty pounds. The scale is accurate and may be used to determine sizes of parts.

blocks along the battens so that the rib will look like the one shown in the drawing on page 83, allowing the space so that the wing spars will go through to serve in place of blocks.

To make up the ribs, 6 blocks are used spaced the right distances and placed in the forms on the bench. One block will come in front of the front spar, three blocks between the front and the rear spar and two blocks on the outside of the rear spar. Place the six blocks on their positions in the form, narrow planed edge fore and aft, and put a good casein glue on the edge of all the blocks. Nail with two ¾-inch nails in each block. Make also six web ribs with the web solid instead of having the blocks in them. This kind of a rib will serve as a stress member in guying up the panels.

The camber shown in the wings by this view of Mr. Duede's glider is modified in the drawings herewith. Mr. Duede says that the camber shown shifted the center of pressure too quickly. Ordinary wing sections do not give enough lift at low speeds. Hence the Duede camber.

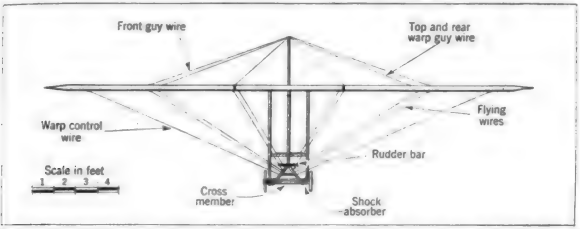
The nine feet long wing spars are ripped so that they will be the same in width as the blocks, or 1⅝-ins. They are beveled a little to allow for the curve of the rib at the place the spar will go through. Mark out the place where the spars have the wing ribs crossing them, and then bore out between the ribs with a half-inch bit so that the spars will be lightened as much as possible.

To assemble the wing, do it the same way as the Heath Parasol is done.

The center wing or plane is about the same procedure. Four halves of hinges are bolted on the front and rear spar, 20 inches apart; the other four halves being used on the ends of the center section struts, by use of cotter keys. Another half of a hinge is placed at the center of front spar for the center strut, another hinge in center of rear spar. The upper parts of both hinges, being left to protrude, are used as terminals for the tripod above.

The center section struts are made of

No Ailerons are Used in This Glider; Wing Warping Gives Stability



The nine-foot left and right wings are attached to a five-foot center panel which is carried by the tail-boom type fuselage.

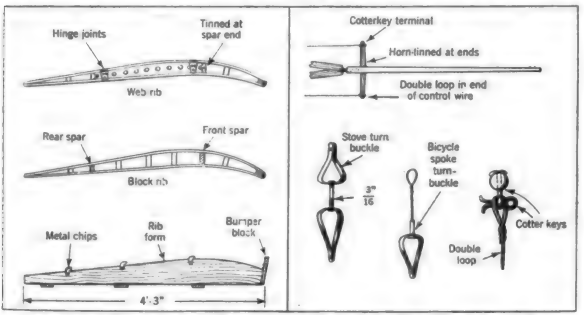
light lumber, streamlined and tinned at their ends to prevent splitting. They come to a V-shape at the bottom of a cross member, which is about two inches wide, and stick out at ends about two inches to allow room for shock absorber rubber to be wound around and over the axle. The shock absorber rubber may be procured by cutting up an inner tube into bands about 1½ inches wide, these being stretched tight over the cross member and axle. About 6 or 8 must go on each side.

The stick control is employed; no ailerons are used. By means of a universal joint at the bottom of the stick made from a hinge, the warp for lateral stability is used by moving the stick sideways, the longitudinal stability is controlled by moving the stick forward and backward in conjunction with control cables which run to the elevators through a pulley at the bottom of the front strut and back through short feed pipe guides.

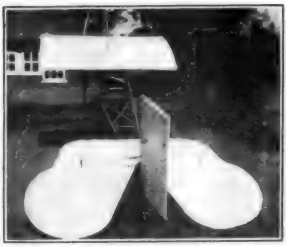
The outer rigging or fuselage is made of three members, ½x1⅛ inches, 11 feet long. A rudder post 17 inches long is at the end with tail skid and shock absorber.

The stabilizer is made of the same size material as used in the rib bats, only the entering and trailing edges are ½x½-inch rounded, the bats nailed and glued on same and a steel umbrella rib is used at the ends to give the desired shape.

In the construction of the elevators the



To the left is shown the end view of the center section panel and how the wings are joined. A section of the typical wing rib is shown in the next view, while to the right are details of wire fittings.



The manner in which the tail surfaces of the Duede glider are constructed is gleaned from this view which is taken from the rear of the glider.

same size material is used, only two umbrella ribs are fastened together to give the shape. The rudder is of the same construction. The control horns on the elevators and rudder are 8 inches long, streamlined and tinned at the ends to prevent splitting. They are bolted at the desired positions with ⅛-inch stove bolts.

A small size cotter key ⅛x1½-inches, can be used at the ends of the horns as terminals. Steel wire about the size of broom wire makes good control wire for elevators and rudder, by making a double loop at the end of the wire,—this makes a good hinge terminal when placed astride

Ready for flight! This photo of the Duede glider was taken just after completion and shows the little ship ready for a trial hop along a hard field.

the horn cotter key eye with another cotter key passing through them. The same size cotter keys are used to make a hinge for the elevators and rudder, by placing two in one member and one in the other, having the one come between the two so another cotter key bent at a right angle can be passed through the eye of all three. The stabilizer has two brace arms made from the steel tubing of an umbrella, fastened on each side at the bottom of the rudder post running out to an angle to about 16 inches from the center at the rear of the stabilizer.

Two small guy wires can also be used from this terminal to the fuselage to make the tail group more rigid.

The glider when complete will have about 96 square feet of lifting surface in the main planes, and should weigh from 60 to 65 lbs.

On account of the glider being so light and having such small lifting surface it will be sensitive on the control, so do not over control at first, and in using the warp for lateral stability the rudder *must* be used in conjunction to compensate the drag, otherwise your control of the warp will not be so effective.

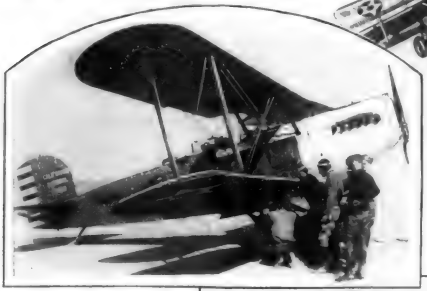
A small size sash cord 100 feet long is used for the flying rope tied on in front of glider held by some one at its end. Two short flying ropes of ten feet in length should be used at first at the end of each wing with a man on them. In a 15 to 25 mile an hour wind, it can be pulled into the wind as a tow-flight machine when the wind is not strong enough for soaring. Be sure you are facing squarely the wind before taking off; if not directly into the wind you are liable to wipe off the landing gear. That is the reason for using the two short flying ropes. When the glider is off the ground the glider is square into the wind.

After you are in the air and you have felt out your controls, it is advisable to fly it the same as a kite for a while. Do not cut loose until you are sure of your controls. In making a landing from a glide, be sure to have men there ready to help hold down the glider, as you will slacken up the flying rope on the glide and the man on the end of it will not have time to tighten the rope enough to keep you from going over backwards if a good puff happens to strike you at that time.

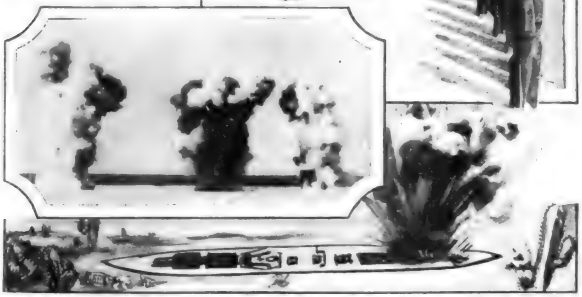
Be *sure* and strap yourself in the glider or you may be thrown out. Rising currents are a great help, but its soaring ability depends on the efficiency of you and the construction.

BOMBING a DESERT Battleship

Out in the Mojave desert Army airmen dropped bombs on a painted battleship to test their sharpshooting accuracy.



Above, airmen are mounting their bombs to an airplane fuselage. A diagram of the battleship California was painted on the surface of a dry lake bed on the desert and the planes flew overhead, dropping explosives which theoretically wiped the warship out of existence. At the right men are shown loading bombs with powder.



Three direct hits! When these bombs struck the vital spots of the painted battleship it was about ready to give up the ghost. Fortunately nothing suffered any damage except the Mojave!

LANDING an ARMY

WILL armies of the future be transported by airplane and dropped at strategic spots behind the enemy lines through the use of parachutes? Tests recently conducted at Brooks Field, Texas, in which detachments of men and machine guns were dropped from a plane all ready for action, may be looked upon as the first step in the development of a new use for the airplane in modern warfare.

The tests were carried out under the supervision of Major S. W. FitzGerald, commander at Brooks Field. Lieut. L. P. Hudson had charge of designing the parachute container used for holding the machine guns, tripods and ammunition.

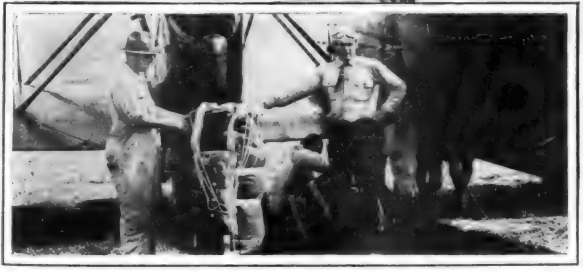
The men dropped from the planes at a height of 1,500 feet, when they were on the ground and out of their harnesses, the machine guns were dropped from a height of 200 feet. Three minutes after the men had leaped from the planes they had assembled the guns and were ready for action.

The top picture shows a parachute carrying a machine gun, dropping to earth in a recent army test at Brooks Field, Texas. In the oval a detachment of men, also dropped from an airplane via parachute, are assembling the gun, which is shown in action in the lower photo.

Via PARACHUTE

Unpacking the gun from its pack.

Airplane to Earth with Gun Set for Action in Three Minutes!



The above photo shows the machine gun packs being fastened to the airplane fuselage, ready for dropping. The various disassembled parts of the guns were carefully packed, as shown, to prevent possibility of damage through a hard landing. The machine guns are dropped from a height of about 200 feet, being released from the bomb bay of an army plane.

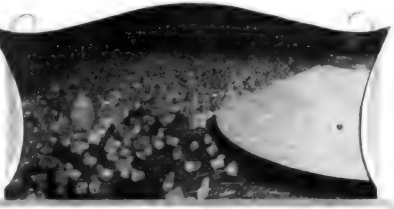
Hatching Chicks by the

Automatic incubators which constantly maintain a correct incubating temperature, and even turn over the hatching eggs, have largely taken the place of the familiar setting hen.

AN ELECTRIC HEN which hatches more than half a million chicks at a time, and produces better birds than the familiar barnyard Biddy ever did, is the latest invasion of science into the poultry field. Under the metallic "wings" of this largest of "hens" 575,000 eggs are placed at one "setting," and more than 97 per cent of these eggs hatch.

The output of thirty large chicken farms goes constantly to this electric hen, at Petaluma, Cal., and a stream of 25,000 fluffy chicks pours daily out of the 1,260 individual built-in electric incubators which produce more chicks, all under one roof at Petaluma, than all the hens and incubators combined in all the remainder of California. Arriving from the farms, the eggs are "candled" and tested by specially designed electric searchlights, which, with the penetration of the X-ray, reveal the fertility of the egg.

These tests completed, thirty tons of eggs, 575,000 of them, are put into trays, as shown in the photograph below, and slipped into the incubators. So specialized is the poultry industry at Petaluma that eggs intended for food uses are produced from hens maintained in small coops, stimulated by special food, and by electric lighting systems which turn night into day.



Thirty tons of eggs are shown above placed on trays ready to be shipped into the incubator, which may be seen on either side of the long row of eggs. The upper photo shows one of the electrically heated brooder pens into which 25,000 fluffy chicks come every day.

MILLION

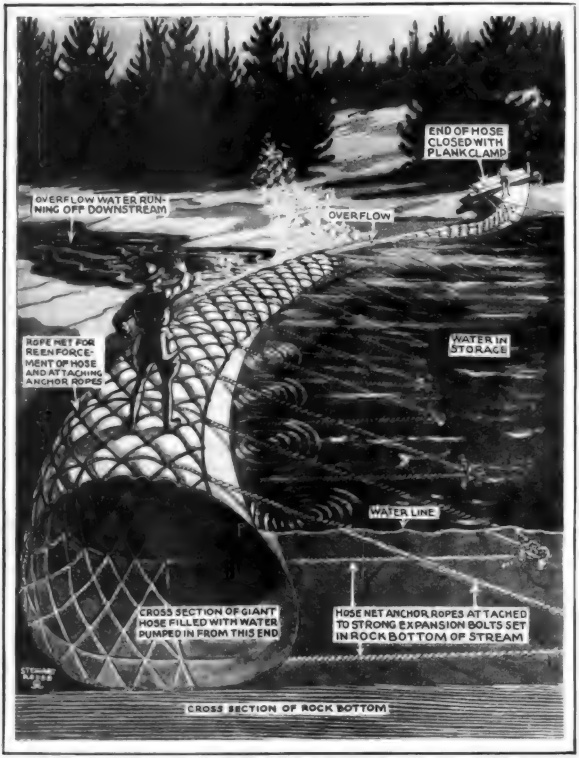
575,000 CHICKS Hatched by ELECTRIC HEN at ONE SETTING

The incubators have automatic thermostat control, maintaining a constant temperature of 103 degrees. Each incubator also has an automatic turning device, which turns 100,000 eggs in ten minutes, with no breakage, and the eggs are turned six times in every 24 hours. This turning is said to improve the size, strength and uniformity of shape of the chick when hatched. All the incubators have signal lights, thermostatically controlled, which tell the operator whether the current is on or off, the number of days the eggs have been in the tray, and the time at which they were last turned. Constant and uniform heat, regardless of outside weather conditions, is maintained automatically.

On the thirteenth and fifteenth days after the eggs are set, all are again tested for fertility, and the infertile eggs removed and destroyed. Automatic indicators show when the chicks begin to hatch in each incubator, and as they come out of the shells, the heat is automatically and gradually reduced until the little fellows are well dried, when a door from each incubator automatically opens, releasing the chicks for shipment.

In the oval is a typical chicken ranch. The center photo shows the control room of the incubator. Below, the chicks are being packed for mailing.

HUGE HOSE



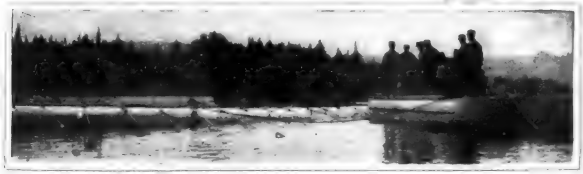
Engineers in Norway, to combat the swollen spring streams, have found that a huge canvas hose, sometimes ten feet in diameter, can be placed across the bed of a stream. This when pumped full of water and securely anchored to the bed of the stream to prevent drifting, will retain water quite effectively. The photos on the opposite page give proof of this fact. In this cleverly executed drawing, Mr. Stewart Rouse shows how the ends of the big hoses are clamped and how the retaining net looks.

DAMS RIVERS

Norwegian engineers have devised this ingenious method of making water dam water so that the terrific floods which attend spring thaws can be effectively harnessed at a few minutes' notice.

This series of photographs shows the methods which drainage engineers in Norway have made use of in bringing rampant rivers under control. As shown in this photo a large canvas hose, reinforced with ropes, is placed across the flood and anchor-stake in much the same manner as a tent.

The hose is filled with water under pressure, and because the relative heads of water give the hose more weight than the stream, it settles and effectively dams the flood.



The ropes which hold the huge hose in place on the bottom are shown in this view rising from the water and encircling the big tube. The water is effectively impounded, as may be seen from the tranquil surface on which the men in the collapsible boat are shown floating.

EUROPE'S BABY CARS

by RAY F. KUNS

DON'T cry, Baby Cars, don't cry—there'll be more of you by and by! Having used a nursery rhyme to introduce the subject I will explain that what I have in mind is a car somewhat littler than a small car—an infant car—and there we are back to the place we started. Baby, or Hush! Hush! cars.

According to our contemporary journal across the pond, *The Motor* of London, to which we are indebted for much of the information appearing herein, a baby car is a creation which is small, little, tiny. A motorcycle with a side car is big and requires more room to get through and more space to park. Yes, that is what we mean, something comparatively infinitesimal.

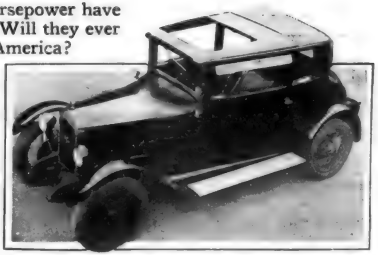
Did you ever have a baby in your house? Yes—and wasn't he just the *best baby?* That is another point where these baby cars earn their right to the title. They *are* good. Their owners will tell the world that they are good, and what is more they have the facts to back them up. These baby cars, like all good babies, put up a fine performance.

In America we have our light cars. They have light cars in Europe also. Their light cars are cars which are about ten to twelve horse power. Our light cars are cars which run from fifteen to eighteen horse power. But a European light car is an overgrown adolescent, compared to the baby cars. Those European hush, hush cars are not so big—I might even say they are not big at all.

Just as a baby has all of the elements of a mature person, so the baby cars have all the appurtenances of the large fellows. Just think of your favorite car and of all

Running out of gasoline isn't so serious when you are the owner of a baby car. The machine is so light that it can be pushed along like a baby carriage, or pulled with a string like a toy model.

Baby automobiles of 7 horsepower have come to stay in Europe. Will they ever become popular in America?



This Austin 7-horsepower coupe illustrates a type of sliding roof which is quite the rage in Europe, not only on baby cars of its type but in higher priced makes as well.

the conveniences and necessities which are built into it and then remember that no matter how tiny the baby car is, it has all of them—in midget size—with not a few gimcracks thrown in. (Gadgets, the British call them.) What it is meant to infer, is that these creations deserve the name car, even though they be babies of the tribe.

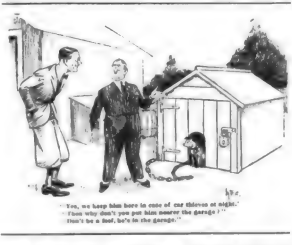
In America all cars, almost without exception, started as baby cars and grew up. That seems to us to be the logical thing for anything to do. But across the pond there seems to be a determined effort to keep them babies. Now you know that is not easy, from an engineering viewpoint. When the engineer gets into close quarters he simply adds an inch or two and then because of that change he has to add an inch or two somewhere else to balance the result.

But in "Merrie Old England" and elsewhere "over there," they have decided that they have need for a breed of Shetland ponies as well as race horses and percherons. What is more, they are getting some high class stock on the market. They are keeping the baby cars tiny and they are solving the engineering difficulties which make their task harder by far than building big cars.

Along with the production of these tiny cars there is being developed a feeling of respect for these creations. Expediency is playing its part there just as it is certain to do here in the years to come. It is not a matter of cost altogether, although high tax rates lead to discouragement of ownership of the large or high-powered car. But England and continental Europe, as every reader knows, are places of congested population. There are not such vast stretches of open spaces as are to be found over here on most week days and once in a while on Sunday. Within limits of twenty miles or so there is admittedly a very large field of service for the baby car. It will save in cost of operation, lower tax rates and in time consumed in getting there. It gets the driver through, around or possibly under, when the big car is held up in traffic. The driver of the big car may look down on the baby car, but by the time he is ready to step on it the tiny tike has scurried away and crawled into some hole which is of no use to anyone else.

According to *The Motor*, garaging of the baby car presents no serious difficulty: "Many town houses, many suburban villas and country cottages have a tool or potting shed at the side which will just house the baby car, although it is doubtful if one of the wide sidecar outfits, now in vogue, could be accommodated."

Continuing, it states: "The large family car will always have its place on tour, but the handiness of the baby for runabout purposes cannot be gainsaid. It is as easy



"Yes, we keep him here in one of our thieves at night." "Then why don't you put him nearer the garage?" "Don't be a fool, he's in the garage."

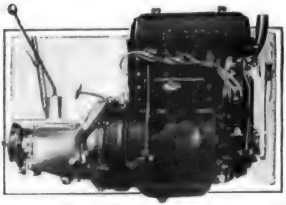
Here is the way in which an English cartoonist takes a good-humored jab at the type of tiny automobile which is so popular with his countrymen.

This Tiny Car Chassis Travels Fifty Miles Per Gallon of Gasoline

Fifty-five miles an hour and 50 miles per gallon of gas is the performance claimed for the Morris baby car, the chassis of which is pictured above. Its power plant is equipped with overhead valves operated by an overhead camshaft, which also drives the generator, or dynamo, as the British term it. The dynamo is mounted on a base at the front end of the engine. Aluminum pistons with two rings are used and the crankshaft is carried in two bearings. The camshaft is driven from a vertical shaft in front which is operated by a skew gearing off the crankshaft. A forced-feed lubrication system is employed.

to fetch and start up a baby car as to wheel a perambulator through the front door."

Baby cars are cars having less than a ten horse power rating. Sevens and nines are the popular ones. The numerals refer to horse power and not to cylinders. Furthermore, baby cars are cars having an overall width of not more than four feet and an overall length of not more than nine feet. That is, if a tall man were run down he ought reasonably to be expected to project on each side, at least one foot, were he found under the car and crosswise of the roadway.



Close-up of the Morris power plant. Its four cylinders have a bore of 2¾ and a stroke of 3¼ inches, with a total displacement of 33.3 cubic inches as compared with a displacement of 150 cubic inches in the average American small car.

The Morris Minor is a baby with a wheelbase of seventy-eight inches and has a tread of forty-two inches. Compare these figures with the smallest car you know.

In England the owners of these tiny cars are not at all averse to standing up for their "babies." They have a very entertaining habit of "writing for publication," with reference to the merits of their own and the shortcomings of the other fellow's car. If the reader will peruse several of the following excerpts from a discussion under way in *The Motor*, he will gain a very real picture of the baby car situation abroad. Commenting on "AVERAGE SPEEDS," one writer says:

"Mr. S. C. Munford refers to an average of thirty-nine miles per hour as a 'wonderful performance for a fourteen horse power car.' This seems surprising to me, especially as the car in question was a six cylinder Talbot.

"In a seven horse power car, costing $625.00, I have made the journey from London to Bristol at an average speed of forty-two miles per hour on one occasion, and on twenty-seven other occasions at from thirty-six miles per hour to thirty-eight miles per hour average. In this Baby Austin I also did four hundred and fifty-seven miles in one day.

"I have made the journey from London to Land's End in eight and one-half hours, in a ten horse power Rover; and I now own what I believe to be the world's best small cheap car—a 9.7 horse power Swift sports. In this fascinating little vehicle I will undertake to average forty-two miles per hour for any length of journey (up to 350-450 miles) on main roads." This was signed—"Senrab."

This rather outspoken missive provoked the preparation of quite a few replies which continued for some weeks. A few are given here:

"I am disappointed. I have owned four Austins and sold the last one only last week. When I covered forty-four miles in one hour and nine minutes I thought I had done fairly well, and it certainly meant hurrying, but I now learn from 'Senrab' that he averaged forty-two miles per hour for one hundred and twenty miles, on a standard model."

"'Senrab' gives us some truly wonderful average speeds for small cars. I suggest that he have his speedometer adjusted."

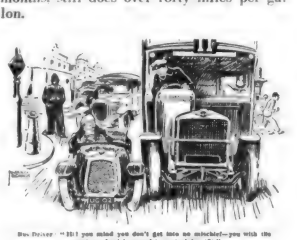
"'Senrab', in his letter, confronts us with specific claims not only as to what he has achieved, but also what he can achieve. Accordingly, he is entitled to greater respect. Now I drive a fast car—at any rate ninety miles per hour is not beyond its capability—moreover, I believe I waste little time, yet as often as not I fail to average forty miles per hour, on long runs made during normal hours. Consequently, I confess, even at the risk of appearing sceptical, that an undertaking on the part of someone else to average forty-two miles per hour under similar conditions on a standard car of 9.7 horse power impresses me more than a little."

"Why is it, when somebody writes about an excellent average put up by a medium powered car, that somebody else immediately 'caps' this by giving an average speed put up by a car of half the horse power, which substantially exceeds the original average, both in miles per hour and probability? 'Senrab' asks us to believe that he can average forty-two miles per hour over a long distance. I have driven an Austin Seven and found the maximum speed to be about forty-five miles per hour. When towns, traffic conditions and other delays are allowed for, what one asks oneself is:

A new German baby car now being developed for the European market. Note how the occupant is forced to stoop in entering the tiny door.

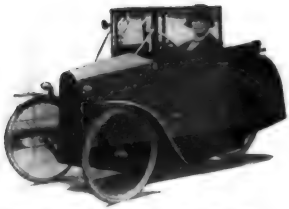
How does he do it? It would appear that anglers no longer hold the monopoly of 'tall' stories."

"It is not with surprise that I have read Mr. Fletcher's letter. He appears to regard an average of thirty-nine miles per hour for a baby car fantastically improbable. Many people do. I have a 1927 two-seater Jowett—a car which, I think, Mr. Fletcher will agree has a 'baby' engine but not a 'baby' body. I have done a distance of twenty-nine miles in under an hour, with one passenger. From Liverpool to Leeds (approximately one hundred miles) I have done in two and one-half hours, which I think is quite creditable for a seven horse power car with a maximum of fifty miles per hour. The car will run happily all day at forty-five to fifty miles per hour; mine very rarely travels at under forty miles per hour and after thirty thousand miles in fifteen months, still does over forty miles per gallon.



Bus Driver: "If I you mind you don't get into no mischief—you with the young mechanic's complete motorin' outfit."

It behooves the driver of a baby car to treat a truck driver with respect—or at least that seems to be the idea of the British cartoonist who drew the above picture.



Cheapest of 'em all—a three-wheeled car sold in London for $100. It is propelled by pedals and has a regular three speed transmission which enables it to develop a speed of 30 miles an hour.

"Mr. John Arthur Fletcher, in his last paragraph, states, 'I was driving at fifty to fifty-seven miles per hour nearly the whole time and passed Swifts and Austins like small fishes.' I happen to be the owner of a Swift and knowing the performance of it and other Swifts, I can safely say that if any drivers of them were in a hurry, then Mr. Fletcher did actually pass them, but certainly did not overtake them. My Swift, which has been hotted up slightly, will do an honest sixty-four to sixty-six miles per hour on the level and once I did sixty-eight miles per hour, with a following wind, slightly downhill."

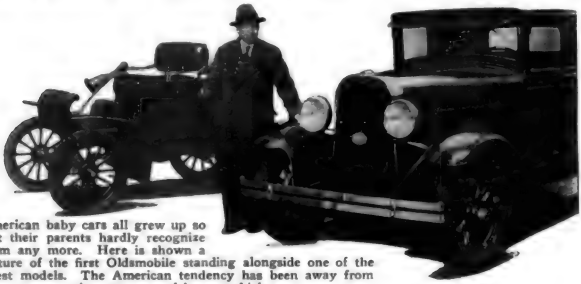
Will America Follow the Lead?

Each year there are a number of foremost engineers and car manufacturers in attendance at the Paris Salon and the Olympia Show. They go for the sake of ideas they may gain with reference to the trend in the foreign market and overseas design. For some years now we have had stress laid on the European type of car, with special reference to the light car field. At no time yet has the public, on this side of the "pond," been ready or willing to accept the very small car, let alone the baby car.

Gasoline costs are lower here. Car costs are lower. Taxes are lower. Here cars are purchased more as a matter of transportation than as a personal possession, about which to wax wrothy if someone belittles it. Of course, we are far from faultless about the car "we bought"—not the one which was sold to us. American car owners are hardly ready for the baby car, which is a hush, hush car to ironical neighbors. Each year does find the light car and the little car more readily accepted.

An early example of a good small car was the four cylinder Saxon. It was low. It was short. It made you feel like "riding in a scoopshovel," but it is safe to say that if the manufacturers of that car had held to the early model and had continued to refine it from year to year and make it smaller each year, rather than larger, the history of the company, long since discontinued, would have been different and it is desired to believe that the baby car would have many supporters in America today.

The baby car is coming. Ere many years we in America will be turning our chicken coops, smoke houses and coal bins into garages.



American baby cars all grew up so fast their parents hardly recognize them any more. Here is shown a picture of the first Oldsmobile standing alongside one of the latest models. The American tendency has been away from tiny cars toward larger vehicles.

Sea-Going Glider Passes First Tests Successfully

AN UNUSUAL type of glider designed for service over water has just been built by Hans Richter, a well known German aviator. The photograph shows his motorless plane just after it had glided to a stop on the completion of its first test flight, which it completed with flying colors. Most gliders are designed for use over land, because of the additional weight of pontoons which add to the weight of the machines, but Richter's glider is so efficiently constructed that the additional poundage did not noticeably affect its flying ability. It is towed by a motorboat to lift it into the air.

Germany has been the leader in glider construction ever since the peace treaty limited the number of man-size motored airplanes which can be built in that country.

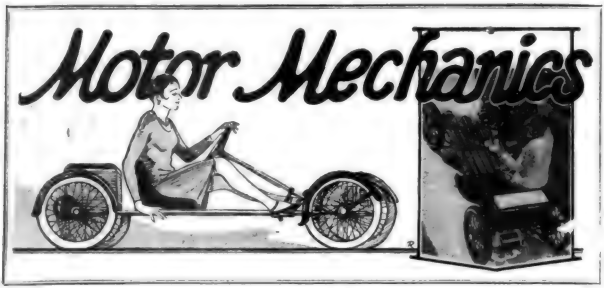
NEW CATERPILLAR WHEELBARROW

CATERPILLAR tractors which proved so successful on tanks during the war are now being adapted to a wide range of commercial uses. One of the latest applications is the tractor barrow wheel shown in the photo at the right. The advantages of such a device are obvious, especially when loads must be wheeled over railroad tracks or other obstructions. The track in the photo stopped the ordinary wheelbarrow, but the caterpillar tread of the other climbed over the obstacle without any difficulty.

Wheelbarrows with caterpillar treads have no trouble in crossing railroad tracks.

PERPETUAL MOTION MACHINE FOOLS PROFESSORS

FOUR hundred college professors were puzzled by the perpetual motion machine built by two students of the Massachusetts Institute of Technology. T. G. Harmon and T. B. Drew, the two inventive students, are shown standing alongside their contraption, which they contrived with the express purpose of puzzling their instructors. Not until a curious inventor came along and brought to light a hidden electric wire was the source of the power which kept a flywheel turning, disclosed. The professors who viewed the machine knew well enough that something was wrong, but they couldn't discover the secret.

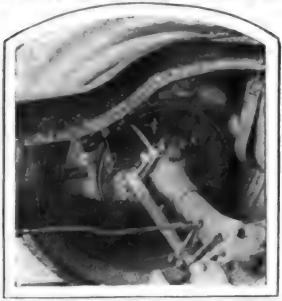


Edited by RAY F. KUNS

Mr. Kuns, the department editor, is director of the Automotive Trade School of Cincinnati, Ohio, and a nationally known authority in his field. Plans for building the "electric scooter" pictured above will appear in next's month's issue of Modern Mechanics.

How to Reline Your Own Auto Brakes

IF YOU really belong to the large family of owner drivers, who do their own repairing or would like to get initiated, the brake relining task is as good as any other to start on. There are several ways of going about the job. You can place the car on the blocks and pull the wheels and then pull the bands and shoes and take them to the supply house where the lining is to be purchased. Some of these houses will place the lining on them without additional charge, just as the oil station places the oil in the crankcase without a service charge. Or you may want to buy the lining and place it yourself. Buy a good grade of lining, as the best is none too good. The brake lining comes in fifty foot rolls and is cut to measure at the supply house. The width and thickness is essential knowledge when making a purchase.



Difficult conditions under which brakes work are illustrated above. Mud, road grease, and dirt of all kinds is spattered against the drums.

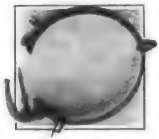
Brake linings give service under hard conditions. They must hold under all conditions of heat and cold, of rain and shine, of mud and water, of oil and grease, and in many cases with very little, if any attention.

When blocking up the car, preparatory to pulling the wheels, make absolutely certain that it is secure. Don't take a chance with your life by working under a car set on a shifting jack. Use blocks, saw horses or other stable blocking. Pull the tires, pull the wheels and with them will come the brake drum. Next remove the cotter pins and the brake pins and other holding devices used to secure the inner brake shoe and the outer brake band.

Order the lining in the length required

and as wide as the steel band and shoe. If the thickness is in doubt, the supply house can look it up for you. Three-sixteenths is the most usual thickness for passenger cars. Use some light clamps to hold the lining. Have a little bow in the lining and after clamping and riveting the ends of the lining, force out the bow and the lining will lay snug against the inside of the band. This is very essential or you will have dragging brakes, difficult of adjustment.

Use a hand drill to drill through the band lining, using a drill just the same diameter as that of the rivets. These may be solid or tubular, copper or aluminum. Countersink with a larger drill bit for the head of the rivet, which should be sunk below the surface of the lining about 1/16". When riveting the job, place the rivet in the hole prepared and allow the head to rest on a flat end punch or bolt, held in the vise. Use the punch rivet set to set the band and lining together and then form the burr on the outer side of the band with one or two good blows. The rivet should be swelled out to fit tight in the hole in the steel of the band or shoe. The burr of the rivet is on the inside of the inner shoe, on the outside of the outer band. The inner shoes are easier to get a snug fitting lining but use care to have no buckles, as this will cause dragging brakes.



Use light clamps to hold the lining in position against the brake band until it is riveted.

When the linings are in place, the next job is cleaning up the brake drum and the brake mounting brackets. See that the adjusting clevises and pull rods are all in good working condition. Lubricate with engine oil where needed. Then install the inner shoes and fit the wheel on the axle and the drum to the shoes to see how the clearance is. Adjust the inner shoes until they take hold as quickly as the hand brake is set a notch or two. Also see that they release as soon as the hand brake lever is released. If there seems to be some trouble about high spots and getting a firm and sound adjustment, start the engine and place the car in gear. While turning the rear wheels, with the engine, set the hand brake and heat up the linings. This will help to form the lining to the inside of the drum.

When, and not before, the inner shoes are performing properly, the outer bands may be applied. The results of any work done on them now will not be confused with the inner shoes as we know they are right. Set these outer bands up at the rear point of the drum until you have .010" clearance. Now go to the center top and set the band at that point to .015" clearance. Then do the same at the bottom of the band and finally for the two ends of the band, at the front of the drum. With these five points actually checked to this clearance, with the thickness gauge, the brake leverage may be gone over and hooked up. Adjust all levers so that they are back of center before the pull comes on them and then when they are pulled forward they will exert the proper leverage. Test the foot brake while the car is on the block and adjust the bands until they hold well and are properly equalized.

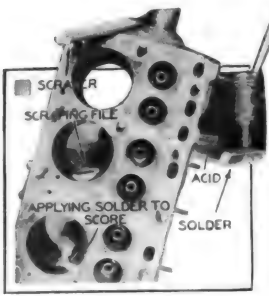
The brake shoe and brake band removed from the car and cleaned up preparatory to riveting the lining.

Once you have mastered the peculiarities of the braking system on your car, you will be able to maintain the brakes properly with very little effort, and you will have the satisfaction of knowing that you can keep them right.

Here is the lining fitted to the outer band. Leave a little bow as shown to prevent dragging brakes.

At first glance, when you have removed the brake shoe and brake band from the car, these pieces of equipment will usually seem to be in rather poor condition, owing to the dirt and grease which has accumulated on them. However, after a bit of cleaning they will be found to be as good as new.

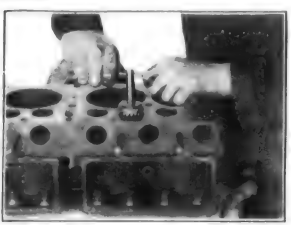
Ordinary Solder Makes Permanent Repair of Deep Cylinder Scores



Reseating Valves

WHEN valves have not been ground for some time it frequently happens that the valve seat has become badly pitted. In order to make a good repair it is necessary to reface the seat in the cylinder block or in the cylinder head as the case may be. This is not a difficult operation but requires a reamer of proper design. In the accompanying figure the workman is demonstrating how a valve seat reamer of 45 degree angle works.

Use a firm, even pressure when starting the reaming operation. Remove just enough metal to clean up the burned portions and leave the surface clean. If too much metal is reamed out the valve will seat in a pocket, which is objectionable. The valve may be refaced if it is badly burned.



The workman shows the proper method of operating a reamer in reseating valves.

OVER a period of years a very definite recognition has been given to the practice of filling in deep cylinder scores with solder. There are thousands of engines operating satisfactorily on the roads which have been repaired by having deep cylinder scores filled in with the ordinary half and half solder, used about tin shops, the average garage, or home work shop.

When it is remembered that the engine temperature will not ordinarily reach 200 degrees and that solder melts at a temperature very much above this point, it will be seen that as long as water is kept in the repaired job it is likely to be entirely satisfactory. Some mechanics who make a practice of doing this work are skilled enough to do it without removing the cylinder block. In other cases it is necessary to have the block pulled out and set up on end on the bench, as shown in the photo.

The first thing to do is to scrape the cylinder score thoroughly and remove all vestiges of oil, grease or dirt. When this has been done and all parts are clean and bright, treat the score with very strong soldering flux. This flux may be the usual soldering acid or a very strong solution of soldering salts. This is necessary as it is difficult to make solder stick to cast iron except by means of a very strong flux.

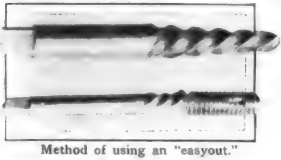
The next point is to fill in the solder until the score has been filled, as will be noted in the photo, cylinder 3, where the soldering iron is shown in use. Do not hesitate to build up the solder above the surface of the surrounding cylinder wall. After this has been done, use a file which has been forged into the form of a scraper, as shown in cylinder 2 and on the top of the cylinder block. These files have the ends turned down and are ground to conform to the general dimension of the cylinder bore. Use care not to scrape the newly applied solder to a point lower than that of the surrounding wall. If the cylinder is to be reconditioned by honing or grinding, the work may proceed after the cylinder has been roughly scraped out. It is not necessary to recondition the cylinder in order to have it operate satisfactorily. Any slight irregularities will be quickly scraped away by the ring and piston action.

Since there is no piston thrust at the point where the cylinder has been soldered, there is no appreciable wear,

FOR MANY years one of the oldest motor car builders held to the wood frame, his contention being that it made for better riding qualities and greater flexibility. Recently one owner of a car of this model found herself with a stalled motor in the path of an approaching interurban car. Results of the collision are shown in the accompanying photo. The driver of the car escaped without injury. Beyond a doubt the story would have been different had there been a steel frame in the car.

Using an "Easyout"

WHEN trying to stop water leaks about the cylinder head or when drawing up parts elsewhere about the automobile, which are held by a number of studs or bolts (there are a number of similar places), the proper procedure is to have things clean before trying to assemble, see that the parts are clean, free of old gasket



Method of using an "easyout."

parts where they meet and that they fit together properly. Assemble with new gaskets of even texture. See that the stud holes are free of carbon or dirt. Start all bolts or studs and draw them evenly. Go over them time after time and finally the job will be tight. Do not try to draw one bolt on a cylinder head to stop a leak.

When a bolt or stud is broken, use a drill to drill into the center of the remaining part. Secure a tool called an "easyout" and run this into the drill hole, turning it to the left. Being wound with a left hand turn it will go into the hole tighter and tighter as the broken end resists turning until finally the grip is sufficient to turn the broken part out.

Tighten Shackles Carefully

When tightening up spring shackles to remove bothersome squeaks and rattles, don't get them too tight or a spring may be broken. When just a bit too snug a spring shackle will give off a disagreeable grunt. When too tight they refuse to give under shock and breaks frequently occur several inches from the spring eye in the main leaf.

Railway Sedan

IN ORDER to facilitate inspection trips of the Canadian Pacific Railway engineers, a Cadillac sedan was rebuilt in the railway shops at Montreal. The job was fitted with steel flange wheels similar to those on any railway coach. The front axle was removed and replaced with one of heavier construction, no steering knuckles being used. The rear axle shafts were removed and the job was fitted with a one piece alloy steel axle. The gear ratio used is 4 to 1. The speed of the machine is the same as that of a car on the highway.

In order to comply with railway regulations, additional lamps were mounted on the front fenders.

There are three braking systems—the

foot brakes, which operate on the rear wheels, the conventional parking brake and a special supplementary set which act upon the front wheels. These brakes are set by turning the steering wheel, no other use being found for it.

Automatic Gear Shift Now Standard Equipment

GEAR shifting has become merely a matter of depressing the clutch pedal since the Armstrong Sidderley Motors Company of England perfected a new automatic shifting equipment. The gear indicator is located on the steering wheel and is fitted with the following gear positions: reverse, neutral, and 1, 2, 3 and 4.

When the driver wishes to change gears in this new model he moves the lever to the indicated position, pushes in the clutch and the gear is shifted automatically. The clutch is then released and the car responds in the new gear.

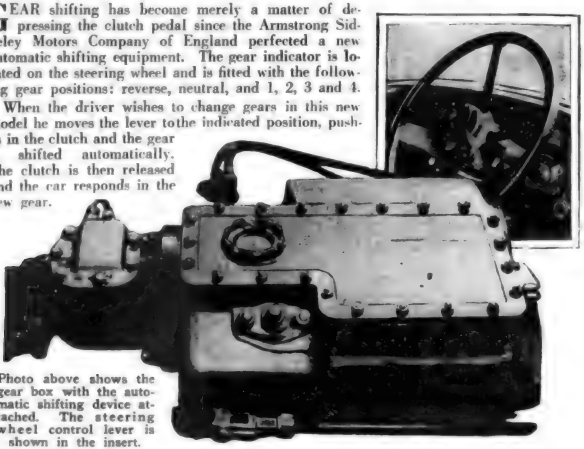
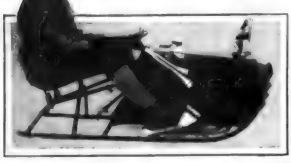


Photo above shows the gear box with the automatic shifting device attached. The steering wheel control lever is shown in the insert.

OVER THE SNOW WE GO!

A NEW type of motor sled which looks something like a toy automobile has been perfected by an Augsburg mechanic, Carl Zeigler. The sled is driven by a 1½ H. P. motor. The movements forward and backward, as well as the steering, are controlled by means of a steel cog wheel. This machine can attain a speed of more than 20 miles an hour over the snow or ice and leaves practically no trace of its passing. This invention is expected to add considerably to the enjoyment of winter sports.



GIANT BEACON PENETRATES FOG

A NEW type of super beacon which can be seen for 100 miles, will penetrate fog, and which is designed especially to direct airplanes and designate landing fields through darkness and storm has been perfected. The giant beacon, which develops the equivalent of 500,000,000 candle-power, uses only about one-third the kilowatt requirements of other forms of illumination, has been tested on several Army and municipal air fields where models have been installed.

The Rainbow Super Beacon, as it is named, is composed of 45 millimeter Rainbow super-tubes, filled with gas and electrified in the same manner as the commercial tube-lights which have been widely developed for out-door illumination during the past few years.

With the development of a successful fog-piercing beacon, one of the most serious hindrances to commercial aviation will have been eliminated.

New Convertible Sedan is Developed in England

AUTOMOBILE owners who desire a closed car that may be converted into an open job will be interested in the roller-blind sliding roof recently exhibited at the London Motor Show on the Rolls-Royce sedan seen in the photo at the right. To open the two roof sections the operator pulls forward on the strap handle and allows the section to slide back. It can be stopped at any point in the same manner that a window shade is controlled. The sliding sections are fitted into a curve or joint in the permanent part of the top so that rain can not spatter in when the top is closed. The joint is so secure that no draft can be noticed on the coldest days.

This standard four door sedan, shown above, may be converted into an open model by sliding back two sections of the roof.

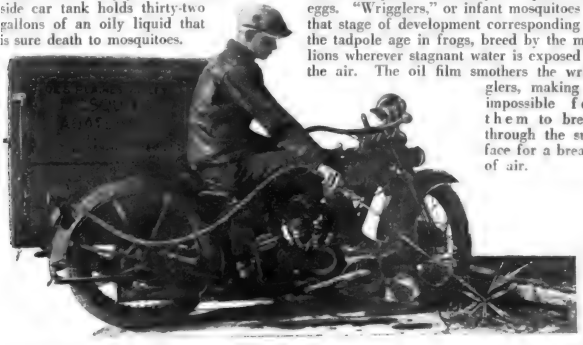
GAS AIDS TELEVISION

BROADCASTING of television images has stimulated a new interest in neon gas tubes. These tubes are known as "sight tubes," or "oramatrons." They change electricity into light waves visible to the human eye as a pink glow in much the same manner as the magnet is used to transmit sound waves in the radio loud-speaker.

The chief function of the "sight tube" is its ability to give out millions of individual pulsations of light per second, corresponding to a like number of charges of electricity.

MOTORCYCLE IS FITTED

SINCE the Des Plaines Valley mosquito abatement district put into service a motorcycle equipped with a side car that carries a tank of acid tar oil, the residents have found summer evenings out doors much more enjoyable. The side car tank holds thirty-two gallons of an oily liquid that is sure death to mosquitoes.



TO FIGHT MOSQUITO WAR

Scientific experimentation has proved that the most effective way to combat the mosquito is to kill the egg larvae before the young can be hatched. The acid tar oil is sprayed on all pools of stagnant water where mosquitoes are likely to deposit their eggs. "Wrigglers," or infant mosquitoes in that stage of development corresponding to the tadpole age in frogs, breed by the millions wherever stagnant water is exposed to the air. The oil film smothers the wrigglers, making it impossible for them to break through the surface for a breath of air.

Above is shown a small, light flying boat. Plans for similar ships will appear in future issues.

The "WHY" of the Flying Boat

by WESTON FARMER

IN THIS article Mr. Farmer, who is a well known boat designer as well as an expert airplane pilot, takes a flying boat apart for you and shows what makes it tick. His design for a "flying bath tub," as pictured above, is a practical model for light plane builders.

FLYING boats are a funny lot. They are as different from land planes as night is different from day, and there seems to be much mystery surrounding the logic of their design. They are simple—but wait till I tell you.

The editors of MODERN MECHANICS have had a great many inquiries concerning the flying of light hydro airplanes. Most of the information which has been gained on light planes has been gained from a study of land types which have been built at one time or another to compete in the various race meets in this country and abroad.

Very few light hydro airplanes or flying boats have been built from which figures on comparative performance data could be gleaned. Therefore the light airplane editor of this magazine has not been able to do more than conjecture, from figures empirically used in design work on land planes, as to what different types would do under conditions mentioned in the letters of light airplane fans who were more in favor of the boat or seaplane than land plane types.

Therefore, a consideration of the possibilities of the light flying boat or seaplane must begin from the ground up, since there is little to draw from in the way of light planes which have been actually built.

There seems to be some mistaken idea as to the relative safety of the two types. Somehow the notion that flying over water is safer seems to be a part of the makeup of every beginning flyer. Generally a boat or a seaplane takes much more skill on the part of the pilot than is the case with land planes. And if that dreamed of crash comes, the water is going to be just as hard and troublesome to bang into as solid sod.

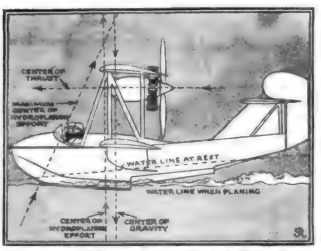
Where reaches of quiet water are found, as at the summer home or near some local lake, there can be no argument against the fact that a fine roomy landing place is available. Boats or seaplanes, however, have much more parasite resistance than wheeled types of ships, and they take more power to fly and to take off with. If they do not have this extra margin of power their flying reserve will be brought down to the point where they are sluggish. Pilots say of them, "They fly at stalling speeds."

These two fundamentals must be considered when a choice of types of light planes is made. One must consider the fact that while water makes a very *convenient* landing place, the size of the light flying boat or seaplane must be larger, heavier, and therefore require more power than land planes of corresponding performances in the air. Their inherently greater resistance requires more power, hence more weight, hence more wing surface to care for the weight, hence larger size.

But granted you have reconciled yourself to these things, what are the main differences between land planes and seaplanes? How do they take off, how are they balanced, and how stable are they? These questions are asked the light airplane editor in great profusion.

In the first place, boats or seaplanes depend upon the planing qualities of a floating member or members placed so as to afford them adequate buoyancy when at rest. This means that under the center of thrust of the propeller there is a comparatively large area to offer resistance.

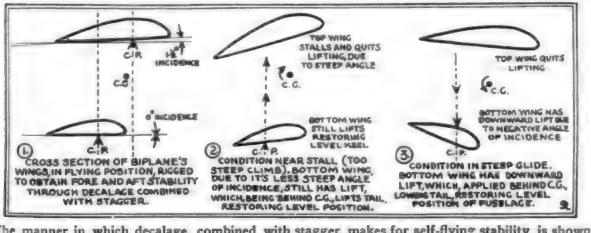
Were it not for the counteracting effect of the stabilizing tail surfaces the natural effect of the thrust and resistance couples would be to turn the plane over on its nose. Not only would this factor be present while in flight, but would be aggravated when landing, as the sudden added resistance of the water would tend to nose the ship more than ever.



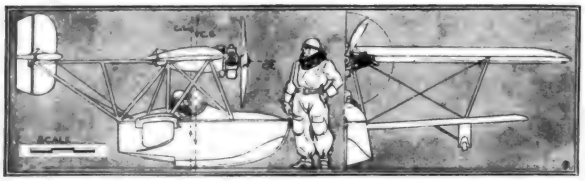
The essential forces which effect a flying boat are shown in this drawing. When they are all in balance normal flight ensues. The way in which the center of hydroplaning effort shifts is clearly shown.

This high thrust and low resistance couple is generally counteracted by using a tail surface which has negative lift, together with a top wing (in the case of biplanes) which has about half again as much spread and area as the bottom wing. This large top wing tends to move the centers of all resistances up toward the motor shaft so that the tendency of the machine to run about the line of thrust is reduced.

It is usual practice with land planes to place the point of contact of the landing wheels on a line which makes a 13 degree



The manner in which decalage, combined with stagger, makes for self-flying stability, is shown in this drawing.



This tiny flying boat is designed for a 30-horsepower Bristol Cherub engine. Plans will appear in an early issue. Watch for them!

angle with the center of gravity. Roughly speaking we may say the wheels, or ground resistance are placed 13 degrees ahead of the center of gravity so as to prevent the plane's prop from pulling her over on her nose when taking off.

With flying boats the center of hydroplane effort, or c.h.e, is placed in the same position. One of the peculiarities of the float type planes comes in at this point. The c.h.e. is shifted "all over the lot," as flyers term it. When a wave hits the bow of the float the c.h.e jumps immediately forward. This is equivalent to having the wheels of a landplane jump suddenly forward. Nothing can be done about it, however, and the only remedy for avoiding this peculiarity is to use smooth water for take-offs and landing.

The water offers a very smooth surface on which to take a plane off from, but it offers further queer traits which must be understood by the designer of light planes.

With land types the resistance mounts steadily, as speed is gained, until the ship reaches its utmost speed and takes off.

On water, the greatest power is required at the moment the hull begins to plane. The resistance of the ship at the moment the hull lifts from the water and gets on the step to plane is as great as the resistance the ship meets when it is flying top speed. Therefore the critical speed and resistance is met in the speed at which the hull planes with a load and the power which is required at this point.

Not only is the hull or float type of airplane different from the land plane in that the pre-flight point of support is apt to shift all over the lot, but in actual flight they differ from land types as night differs from day.

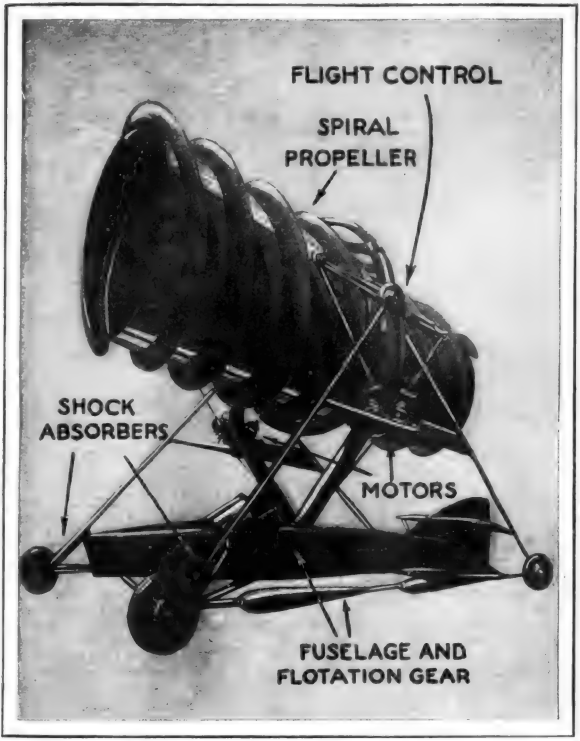
For one thing, the weights as well as the resistances are all below the center of thrust. When banking for a turn the flying boat tends to overbank, because of the pendulum effect of the weights tending to throw the hull outward. It is easier to over-control a flying boat than it is to over-control a land type.

Shown in the drawings accompanying this article are suggestions for a small boat which might be built by amateurs. The editors of MODERN MECHANICS have under consideration at the present time several plans for light seaplanes and flying boats, and it is with the thought that the fundamental differences should be appreciated by light plane fans that this and subsequent articles on the light type of flying water craft are written. The "Flying Bathtub" as designed by the writer has many points in its favor. The wash drawing by Stewart Rouse suggests its possibilities in flight, while other views show the plane views and how the biplane decalage effect might be used to stabilize the ship. Almost all biplanes are capable of being made inherently stable by the use of decalage, and the manner in which this placing of the wings gives rise to fore and aft stability of the ship is shown in the accompanying drawing.

Next month we will go further into the peculiarities of the flying boats and seaplanes of the light type. Space does not permit more at this time, but the writer, who has designed many of the well known racing boats of the country, together with the famous pilot, Gene Shank, will show you how these planes may be developed for amateur use and eventually MODERN MECHANICS will publish full details for the building of one when the editors have decided upon the best plans.

See you next month!

"Fly Worm" *is New Flap in* FLYING!



The most recent invention in the way of strange new craft for flying is known as the "Flyworm." It is the brain child of a San Diego, Cal., inventor. The queer craft has no wings, nor propeller, and is intended, so advices state, to rise from the tarmac without a running start. Other features of the new design are its promised ability to attain a high speed with a low engine speed, and to run in the air, on land and in the water. Small models have been satisfactorily tested. The large hollow worm is the propeller and in some manner not made known by the inventor this element also sustains the craft in flight. It is planned to test fly the full sized model with radio control.

Major Arnold

Edited by MAJOR H. H. ARNOLD

How do you like Major Arnold's new photograph which appears above? It shows him in his uniform as an officer of the American Air Service, of which he was Assistant Chief during the World War. This month he continues his authoritative discussion of recent developments in airplane engines.

Air-Cooled Engine is New Tendency of Design

WAR has always provided a stimulus for the development and improvement of things mechanical. The World War was no exception to the rule. However, there were certain aspects of the World War which prevented rather than helped the development of airplane engines, at least during the early part of the war. The mere fact that there were so many different countries engaged precluded the confinement of engine development. Each country had its own ideas as to the general lines along which engines should follow and each hesitated about departing from the course which it believed to be correct.

While this condition made possible the production of many different types of engines, few individual types received the concentrated thought of a large number of engineers. Until the time that the United States entered the World War, Germany was the only country which concentrated upon a particular type of engine and then continued to improve it, thereby securing more efficiency with each model produced. They standardized upon the six-cylinder, vertical, water cooled engine and used it for all airplanes and also for their Zeppelins.

England had the Beardmore, Rolls-Royce and several French types. France used the Gnome, Clerget, Renault, Salmson, Le-Rhone, Loraine-Dietrich and others—all different types. Some were rotary air cooled, some radials and others water cooled. Italy produced the Fiat, Isotta-Fraschini and the S. P. A. It is true that all of these engines improved during the war, but the activities were more or less unco-ordinated.

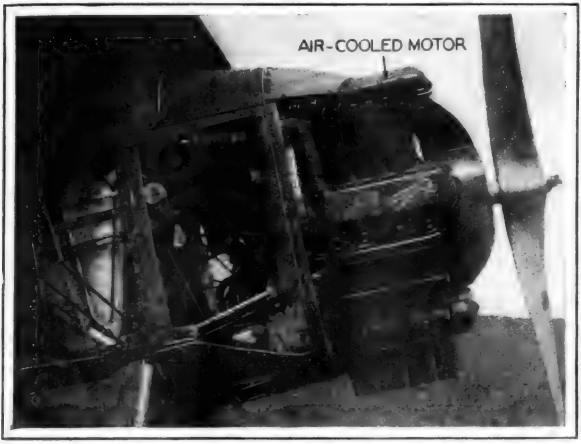
The necessity for a standard engine for the Allies became apparent about the time that the United States entered the war. Then followed the production of the Liberty engine for the use of all the Allied countries. At the time of its appearance it was several years ahead of time in power produced. For several years following the war it con-

Will oil burning engines ever be developed for airplane use?

Why is the radial type of motor such as Lindbergh used so popular today?

Do airplane manufacturers still use water-cooled engines in their machines?

Read the answers to these questions in Major Arnold's article on this page.



Above is shown a Curtiss Chieftain radial motor installed in an Army plane. This motor develops 600 horsepower on a weight of 900 pounds, making it an exceptionally efficient airplane engine. It is a 12 cylinder air-cooled job.

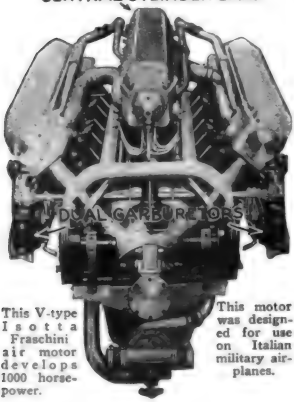
tinued to be used, not because a better engine was not desired but because there was not sufficient demand to justify the engineering and development costs of a more improved type. The stimulus of war stops with the peace treaty. Following that all nations cut costs and expenses and endeavor to run along on war materials. Commercial aviation had not developed sufficiently to warrant new types being brought out by the factories.

Prior to 1923 the water-cooled engine stood head and shoulders above the air-cooled. The rotary type was entirely too temperamental and delicate for general use. The radial had not as yet proved its reliability. All engineers admitted the superiority of the air-cooled engines provided that they could meet the requirements of aviation. The water-cooled engines had established a high standard for reliability and it was but natural that the first of the radials should fall short of that standard.

The Lawrence Aero Engine Corporation was one of the few companies which realized the advantages of the radial type and continued experiments to produce such an engine for general use. This development was assisted by our government and in 1922 the Lawrence J-1, 9 cylinder, 220 H. P. engine was ready for production. It was not as yet free from "bugs" but no aero engine is until after it has had two or more years of service use.

The following year, the Lawrence Company united with the Wright Aeronautical Corporation. This practically insured the success of the radial engine, for the combination of Lawrence's knowledge and experience with the air-cooled types and the Wright Corporation's experience with engine construction and production made a team that was bound to deliver the goods. The foundation for the aeronautical air-cooled engine industry was laid.

The enormous, present day demand for airplanes and engines for commercial purposes is of recent origin. It might well be



This V-type Isotta Fraschini air motor develops 1000 horsepower.

This motor was designed for use on Italian military airplanes.

said that it started with Lindbergh's flight across the Atlantic. Prior to that the United States government brought practically 90% of all aeronautical material produced. Accordingly there was not much demand for low-powered engines. The Army, Navy and Post Office Department required at least 400 H. P. for their service ships.

The J-1 soon came out as the J-4 or, as it is commonly called, the Whirlwind. Quite a few of these engines were produced and had the "bugs" taken out. Thus the Whirlwind was standardized as a reliable engine for commercial purposes. It received its first strenuous test in Byrd's Polar flight in May, 1926. When Byrd and Bennett completed that hazardous trip from the island of Spitzbergen to the North Pole and return, all doubts as to the reliability of the Whirlwind engine under the extremes of temperature and under the severest kinds of strains were removed. The engine was a success.

The next manufacturer of radials to appear on the scene was the Pratt & Whitney Company. They brought out their first engine in 1925. It was called the Wasp and produced about 400 H. P. Thus the air-cooled engine industry in the United States was established. It remained but for Lindbergh, Byrd, Chamberlin, Maitland and Hegenberger to successfully complete their record flights and the demand for commercial planes with economical engines was far greater than the supply.

At the present time the number of water-cooled engines used in commercial planes is very small. The radial type is the accepted aircraft engine. With the great demand other factories came into being and now there are many sources of supply of this type of aero engine.

The development of the water-cooled engine has proceeded along orthodox lines. Improvements have been made in carburetion, ignition and in oiling systems. A much higher compression ratio is used and a saving in weight has been effected by using lighter metals with the same strength, but the water-cooled engine must have its heavy radiator, large quantity of water and attendant pumps and pipes.

Recently an oil engine of the Diesel type has been tried out as an airplane engine. There is no doubt that if a practical oil burning airplane engine is ever developed, it will immediately be accepted by airplane designers and aviators as one of the greatest advances made in modern times in aviation. The oil burning engine does away with the gasoline fire hazard, ignition systems, carburetors and also provides for the use of a much less expensive fuel.

The oil burning engine, successfully tried out at Detroit, is of the radial, air-cooled type and delivers 200 H. P. However, it is considerably heavier than the radial gas engine, approximately three pounds per H. P. against two pounds. It is interesting to note that the two super airships which Great Britain is building are both to be equipped with oil burning engines.

Another interesting development in engine construction is the Fairchild Caminez engine. This engine eliminates many movable parts by transmitting the power produced through the pistons, through rollers to a large cam-shaped crank shaft. This engine is also air cooled, weighs 360 lbs. and delivers 150 H. P. It eliminates connecting rods and their crank shaft bearings. This engine has practically passed through the experimental stage after about two years of service in planes.

Neon Gas May Conquer Fog, Worst Foe of Commercial Flying

Dangers of blind flying in fogs and through clouds are well shown by this photograph. Jagged mountain tops often hide behind clouds of fog, and airplane pilots have frequently crashed into mountain sides when flying blind. Through the use of an electric current passed through neon gas, a fog-penetrating light is obtained which may eliminate blind flying dangers.

BLIND flying is necessary when fog or rain shuts off all view of the ground. There have been numerous devices invented with a view of eliminating the danger of flying blindly into an airdrome for landing. The radio beacon idea was tried out in several ways before it was thrown into the discard for such purposes. The French laid a line forty or fifty miles out of Paris believing that the pilots could fly along over it using the signals emanating from the cable to keep them directly over it. However, after several tests this was given up as impracticable. The radio signals could not tell the pilot how high above ground obstacles he was.

For a while in this country we believed that we had the solution in using electrified particles of sand. By charging sand with the opposite kind of electricity from that in clouds, it was found possible to dust the sand over the clouds from an airplane and cut a path through. Later attempts were made to project the electrified sand into the air from an airdrome and dissipate fog. While both of these methods of using electrified sand have been partially successful, they are not as yet practical.

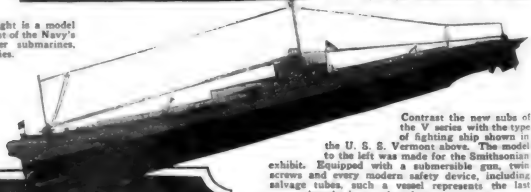
The latest device used to open a way through the fog and clouds for the aviator is based upon light penetration. Practically every known kind of ray has been used with little success. The small drops of water seem to form an impenetrable blanket to all kinds of light. However, quite recently tests have been made with a neon gas tube which give greater promise than any other device as yet tested.

When neon gas is used in an electric tube and a current run through the wires, a golden red light is obtained. It has been found that this light penetrates fog. At the present time there is a neon beacon installed near New York for test. From the results obtained it looks as if it will soon be possible for the aviator to fly in and land on an airdrome through the thickest fog. If such is the case the biggest obstacle in the road of commercial aviation will have been removed.

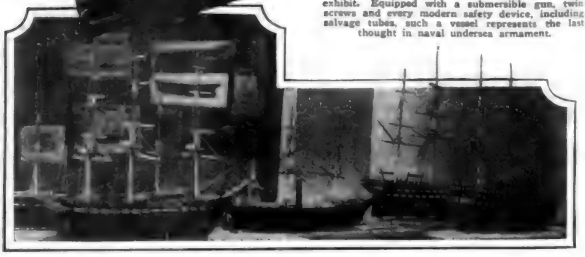
Marvelous Tell History

This model is of the U. S. S Vermont, sister ship to the re- doubtable Constitution. The model is in the Smithsonian collection.

To the right is a model of the first of the Navy's new super submarines, the V series.



Contrast the new subs of the V series with the type of fighting ship shown in the U. S. S. Vermont above. The model to the left was made for the Smithsonian exhibit. Equipped with a submersible gun, twin screws and every modern safety device, including salvage tubes, such a vessel represents the last thought in naval undersea armament.

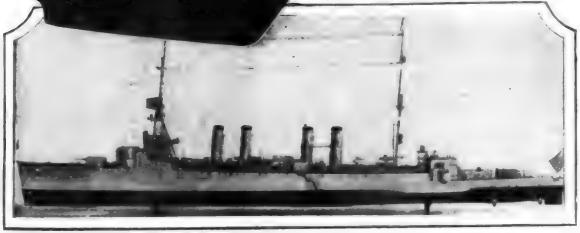


This collection of models is part of the famous group in the Kensington Museum in London, England. Here the sea-loving soul of the Briton has manifested itself in the collection of models of all of the important ships of history so that the generations of tomorrow may see what the ships of yesterday and today look like. In this photo are shown Bon Homme Richard, the Savannah, and ships of the eighteenth century.

MODELS of Romantic SHIPPING

Two experts of the Washington Navy Yard model testing tank at work on the hull of the U. S. S. Richmond, pictured at the bottom of the page. So much skilled hand work goes into such a model that its worth is often over $10,000!

To the left is a wonderfully executed model of an early British man-o-war. The amount of labor involved in the construction of such a model is even greater than that in the building of one of the type such as the Richmond.



This wonderful scale model of the U. S. S. Richmond, nearly twelve feet long, is built exactly in proportion to the dimensions of the prototype. Small searchlights have scratches on the lenses to simulate the fresnels of the lights they copy; tiny turrets have elevating gun controls; rigging is all "according to Hoyle"—even the Tom Thumb size life boats are equipped with oars, locks, seats and rudders.

Canadian Railway Maintains Fire Fighting Force

WHEREVER the lines of the Canadian National Railways run through densely wooded territory, the road maintains special fire fighting equipment to cope with outbreaks of fire in the timberland. This equipment consists of a tank car that has been fitted with pumps and hose containers. Whenever a fire call comes in, an engine is coupled to the tank fire engine and the firemen are rushed to the scene of the conflagration.

ANCESTORS OF MOVIES DISCOVERED IN HOLLYWOOD

DO YOU remember the old days when a moving picture show was riffled before yours eyes through a peephole for a penny? A reminder of the earliest movie was found recently in the studio of Metro-Goldwyn-Mayer at Hollywood. It was the vintage of 1900, years before the movies attained the status of an industry.

William Haines, the movie actor, is shown below looking at "The Interrupted Sitting," a penny movie which, according to the wording of the advertising placard shows "a celebrated artist working with a famous model when his wife called at the studio." This picture was portrayed by means of a series of individual shots attached to a circular disk which rotated rapidly when the crank was turned, making each blend into the next, giving the moving picture effect.

William Haines and his cameraman, Merritt Garsted, are seen looking over an old "Mutoscope" which was recently unearthed in Hollywood. It is one of the old put a penny-in-the-slot-and-see-the-pictures type.

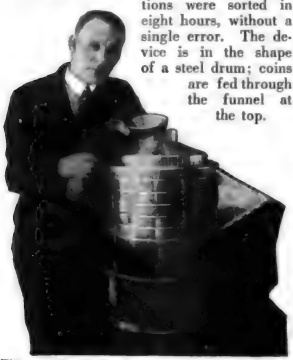
Work Halted on $1,000,000 Mountain Sculpture

ALL WORK on the Stone Mountain Confederate Memorial has been held up pending the outcome of charges brought by Samuel H. Venable, one of the owners of the huge granite mountain, that the association sponsoring the gigantic carvings on the mountain side has spent more than a million dollars in the last two years without having anything to show for it.

The photo at the right shows the partially completed head of General Robert E. Lee, modeled by Augustus Lukeman. General Lee is the central figure of the great panel showing leading figures of the Confederacy. Some idea of the tremendous dimensions of the relief statues may be gained from the fact that the head shown in the picture is more than twenty feet high. The Memorial scheme has experienced many vicissitudes. Gutzon Borglum, the first sculptor in charge, resigned after a disagreement, and now lack of funds has imperiled completion of the original plan.

RAPID COIN SORTER

A NEW style coin sorter which uses centrifugal force to separate coins of different dimensions into their proper slots is shown in the photo below. In a recent trial, 36,000 coins of varying denominations were sorted in eight hours, without a single error. The device is in the shape of a steel drum; coins are fed through the funnel at the top.



This mechanical coin sorter separates coins through centrifugal force which throws them into their separate slots.

NEW SURGICAL CAMERA

ONE OF THE latest advances in medical science is a tiny surgical camera recently tested for the first time when it was swallowed by a New York convict and pictures were taken of the interior of his stomach to determine the degree of recovery from an operation for gastric ulcers. The camera is a tiny device which furnishes its own illumination. It resembles a stomach pump, with a long control tube through which the operator exposes his pictures.

OCEAN AIRLINES PLANNED

THREE transatlantic lighter-than-air lines will go into service this year following the Graf Zeppelin's successful flight from Germany to the United States. British, German, and Spanish interests are behind the proposed lines, and announcement of plans indicates that the day of air transport on luxurious liners has actually arrived.

Two British dirigibles, the R-100 and the R-101, are now nearing completion and will soon be ready for service. Three day trips between London and South American ports are planned, which will effect a saving of almost two weeks over the regular steamship time. The pioneer trip of the Graf Zeppelin impressed business men with the savings to be effected by air transport.

Winners in NEW USES

EVERY reader of Modern Mechanics who has discovered a new use for old Fords will be paid $10 for each photo of the device accepted by the editors. Send your discovery to the editors!

Paul S. Gesswein designed this splendid little boat which goes like the wind with a redesigned Ford type power plant. The wake has not settled for a quarter of a mile behind the little speeder!

WELL, it looks as though old tin Elizabeth is going to be going strong for another ten years at least!

The uses to which motors from old model T Ford cars have been put would challenge the imagination of a Jules Verne. The uses we picture this month are not particularly of the far-fetched type; rather they are given to show what can be done with these versatile, cheap little power plants.

Above is shown a small runabout which was designed by Paul Gesswein, Gesswein Boat Co., Bergen Beach, Brooklyn, N. Y. Fitted with a motor of rebuilt Ford type, using valve in head cylinder block, this little 19 footer can travel all day long above a thirty mile an hour clip. Many readers of Modern Mechanics are highly interested in boats. Some have suggested the possibility of publishing plans for a fine little boat of the high speed type which would use a Ford motor. Plans are under way at the present writing to furnish readers of Modern Mechanics with a design very similar to the one shown in the photo above. High speed boating!

AND AIRPLANES? The light airplanes editor of Modern Mechanics secured the photo below from the Allison Airplane Co., Lawrence, Kansas. It shows a prettily proportioned, sturdy one place biplane which has a rebuilt Ford at the business end of the toothpick prop. The high speed is said to be well over seventy miles an hour, with a useful load of about 300 lbs.

Note that the usual Ford radiator is used, as shown in the cut below. The Allison Company sells blueprints for this ship and have reported several as having been built and successfully flown. The span is 26 feet, the length 20 feet, and a double aileron, top and bottom wing, design is used.

Such a ship, while a bit harder to build than the MODERN MECHANICS series of light planes, would be easy to power and should make a good ship on which to build up the necessary 200 hours flying time required for the highest license one can obtain, namely 200 hours.

John M. Allison, Aeronautical Engineer of Lawrence, Kansas, designed and has successfully flown this little biplane. A Ford Motor is used as power. The span is 26 feet, the length 20 feet, and it is reported that several students have built this type of plane and have built up the necessary hours for obtaining a Transport Pilot's License.

for Old Fords CONTEST

On the Thames River in England this Ford powered hydro glider is used. The twenty-two foot hulls, with room for eight passengers, are clearly shown in the above layout. Note the manner in which the Ford is mounted, driving the boat through a four bladed propeller. This permits a smaller diameter propeller to be used.

UP THE bally Thames this air propelled boat recently made its way at a respectable speed. It is powered with a model T engine, transmission and all, and is mounted in much the same way as the Henderson motor was mounted in Gilbert Mickelson's Aero Ice Sled, which appeared in the February issue. Starting crank, fourbladed prop, water pump—all the rhubarb and grapefruit necessary for running the conversion are included in a well turned out job.

The hull, which Americans would term a "pontoon job," Frenchmen a "hydroglisseur," and Englishmen a "catamaran," is long enough to comfortably support the center passenger cockpit accommodating eight people. The wheelsman is located at the controls in the stern of the hull and has a set of instruments such as are mounted on the dashboard of the ordinary Ford car.

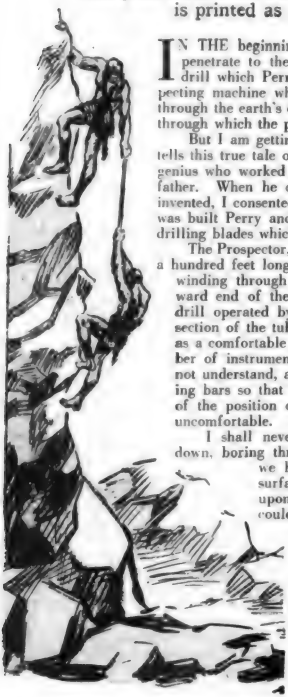
The motor is mounted on stalwart 3x3 inch fir bearers which are wired and trussed in the same manner in which the fuselage of airplanes are built.

It is interesting to conjecture whether a craft of this type, which would have a speed of about 15 miles an hour, would not be a money earner in the livery business. The hull would be inexpensive, the motor cost low, and no doubt on many lakes such a boat would prove an attraction.

LOST *Inside the* EARTH

by EDGAR RICE BURROUGHS

A huge man-carrying drill runs off its course and carries its helpless occupants to the very center of the earth, where they meet with the most astonishing adventures to be found in present day fiction. Begin this great serial now; a summary of previous chapters is printed as part of the story.



IN THE beginning, of course, I never dreamed that I would penetrate to the very center of the earth. The immense iron drill which Perry had invented we simply regarded as a prospecting machine which would enable us to bore a short distance through the earth's crust, bringing back samples of mineral deposits through which the prospector passed.

But I am getting ahead of my story. I am David Innes, who tells this true tale of incredible adventure; Perry was an inventive genius who worked for me in the mines I had inherited from my father. When he came to me with the prospecting machine he invented, I consented to finance him, and when the boring machine was built Perry and I were ready to step within it and guide the drilling blades which we hoped would carry us on to fortune.

The Prospector, as we named the machine, was a steel cylinder a hundred feet long, jointed to make it as flexible as a serpent in winding through the solid rock it was to penetrate. The forward end of the queer machine contained a mighty revolving drill operated by an engine of tremendous power. The inner section of the tube contained a chamber which we had fitted up as a comfortable room. True, it was equipped with a vast number of instruments and cogs and devices whose purpose I did not understand, and we sat in seats which were joined to swinging bars so that we would always be sitting upright regardless of the position of the Prospector, but still the room was not uncomfortable.

I shall never forget the moment when we started, nose down, boring through the earth like a giant mole. Not until we had penetrated five hundred feet beneath the surface did we begin to realize that disaster was upon us. Perry, wrenching at the steering device, could not budge it, nor could our combined strength move it a fraction of an inch! We were boring toward the very core of the earth, helpless to change our course to escape the strangest, most terrible doom that ever befell mortal men!

On that horrible trip I shall not dwell; my scalp prickles with a cold sweat and my flesh crawls at the stifling memory of it. We passed through strata of terrific heat and tremendous cold, and at the critical moment when Perry and I were un-

A Novel of the World at the Earth's Core

by the Author of "TARZAN"

conscious from the failing oxygen supply of our tanks we burst forth into an atmosphere of pure fresh air.

On emerging from what was so nearly our death chamber, we discovered that we stood in a world utterly strange to us. A ball of fire, three times as large as our ordinary sun, hung motionless in the very center of the sky. The earth had no horizon; it curved *upward*, like the inside of a bowl, and we knew that we stood in a weird country at the center of the earth!

Scarcely had we got beyond the bounds of the Prospector in exploring this new land when we were attacked by a tremendous shaggy beast which Perry said was a creature of the type which had roamed the earth in the stone age. We were rescued from his clutches by a gibbering horde of hairy ape men who captured us and took us to their tree village.

The next day we were escorted to an arena and turned loose before the fangs of a pack of *hyaenodons*, which were fierce, wolf-like animals. Perry and I had resigned ourselves to our fate when the slaughter was interrupted by the appearance of a column of hairy men who set upon our captors and killed them all. This, however, did not aid us greatly, for the conquerors chained us at the end of a long column of captives, most of whom were men and women like ourselves—white creatures of striking appearance.

Especially was I attracted by a young woman who was chained in front of me in the line. I learned that her name was Dian the Beautiful. An unprepossessing man who bore the name of Hooja, the Sly One,

The huge labrynthodon, mouth agape and jaws slavering, rushed forward in a resistless charge that I knew would mean the end for us.

chained alongside her, annoyed her with his offensive attentions. His hand fell on the girl's bare arm, jerking her roughly toward him. She shot me an appealing glance. Rage bubbled within me. Before he could lay hold of her with his other hand, I placed a right to the point of his jaw and felled him in his tracks.

Dian Disappears

A ROAR of approval went up from those of the other prisoners and the Sagoths who had witnessed the brief drama; not, as I later learned, because I had championed the girl, but for the neat and, to them, astounding method by which I had bested Hooja.

And the girl? At first she looked at me with wide, wondering eyes, and then she dropped her head, her face half averted, and a delicate flush suffused her cheek. For a moment she stood thus in silence, and then her head went high, and she turned her back upon me as she had upon Hooja.

Immediately after we resumed the march, and though I realized that in some way I had offended Dian the Beautiful I could not prevail upon her to talk with me that I might learn wherein I had erred—in fact I might quite as well have been addressing a sphinx for all the attention I got.

We were approaching another range of mountains at the time, and when we reached them, instead of winding across them through some high-flung pass we entered a mighty natural tunnel——a series of labyrinthine grottoes, dark as Erebus.

The guards had no torches or light of any description. So we crept along at a snail's pace, with much stumbling and falling—the guards keeping up a singsong chant ahead of us, interspersed with certain high notes which I found always indicated right places and turns.

Halts were now more frequent, but I did not wish to speak to Dian until I could see from the expression of her face how she was receiving my apologies. At last a faint glow ahead forewarned us of the end of the tunnel, for which I for one was devoutly thankful. Then at a sudden turn we emerged into the full light of the noonday sun.

But with it came a sudden realization of what meant to me a real catastrophe—Dian was gone, and with her a half-dozen other prisoners.

Of the twelve prisoners who had been chained ahead of me each alternate one had been freed commencing with Dian. Hooja was gone. Ghak remained. What could it mean? How had it been accomplished? The commander of the guards was investigating. Soon he discovered that the rude locks which had held the neckbands in place had been deftly picked.

"Hooja the Sly One," murmured Ghak, who was now next to me in line. "He has taken the girl that you would not have," he continued, glancing at me.

"That I would not have!" I cried. "What do you mean?"

He looked at me closely for a moment.

"Then shall I tell you. When a man of Pellucidar intervenes between another man and the woman the other man would have, the woman belongs to the victor. Dian the Beautiful belongs to you. You should have claimed her or released her. Had you taken her hand, it would have indicated your desire to make her your mate, and had you raised her hand above her head and then dropped it, it would have meant that you did not wish her for a mate and that you released her from all obligation to you. By doing neither you have put upon her the greatest affront that a man may put upon a woman."

The Buried City of Phutra

"I DID not know, Ghak," I cried. "I did not know. Not for all Pellucidar would I have harmed Dian the Beautiful by word, or look, or act of mine. I do not want her as my slave. I do not want her as my—" but here I stopped. The vision of that sweet and innocent face floated before me amidst the soft mists of imagination.

I asked Ghak if there was not some way in which I could release the girl from the bondage and ignominy I had unwittingly placed upon her.

"If ever you find her, yes," he answered. "Merely to raise her hand above her head and drop it in the presence of others is sufficient to release her; but how may you ever find her, you who are doomed to a life of slavery yourself in the buried city of Phutra?"

Two marches later we came to the city of Phutra. The entrance to it was marked by two lofty towers of granite, which guarded a flight of steps leading to the buried city. Sagoths were on guard here as well as at a hundred or more other towers scattered about over a large plain.

Captives of the Mahars

AS WE descended the broad staircase which led to the main avenue of Phutra I caught my first sight of the dominant race of the inner world. Involuntarily I shrank back as one of the creatures approached to inspect us. A more hideous thing it would be impossible to imagine. The all-powerful Mahars of Pellucidar are great reptiles, some six or eight feet in length, with long narrow heads and great round eyes. Their beaklike mouths are lined with sharp, white fangs, and the backs of their huge, lizard bodies are serrated into bony ridges from their necks to the end of their long tails. Their feet are equipped with three webbed toes, while from the fore feet membranous wings are attached to their bodies just in front of the hind legs.

As we continued on through the main avenue of Phutra we saw many thousands of the creatures coming and going upon their daily duties. They paid but little attention to us. Phutra is laid out underground with a regularity that indicates remarkable engineering skill. It is hewn from solid limestone strata. The streets are broad and of a uniform height of twenty feet. At intervals tubes pierce the roof of this underground city, and by means of lenses and reflectors transmit the sunlight, softened and diffused, to dispel what would otherwise be Cimmerian darkness. In like manner air is introduced.

Perry and I were taken, with Ghak, to a large public building, where one of the Sagoths who had formed our guard explained to a Maharan official the circumstances surrounding our capture. The method of communication between these two was remarkable in that no spoken words were exchanged. They employed a species of sign language.

They set us to carrying a great accumulation of Maharan literature from one apartment to another, and there arranging it upon shelves. I suggested to Perry that we were in the public library of Phutra, but later, as he commenced to discover the key to their written language, he assured me that we were handling the ancient archives of the race.

At my suggestion Perry and I fashioned some swords of scraps of iron which we discovered among some rubbish in the cells where we slept, for we were permitted almost unrestrained freedom of action within the limits of the building to which we had been assigned.

We hid our new weapons beneath the skins which formed our beds, and then Perry conceived the idea of making bows and arrows—weapons apparently unknown within Pellucidar. Next came shields; but these I found it easier to steal from the walls of the outer guardroom of the building.

Plans for Escape

WE HAD completed these arrangements for our protection after leaving Phutra when the Sagoths who had been sent to recapture the escaped prisoners returned with four of them, of whom Hooja was one. Dian and two others had eluded them. It so happened that Hooja was confined in the same building with us. He told Ghak that he had not seen Dian or the others after releasing them within the dark grotto.

"Ghak," I said, "we are determined to escape from this bondage. Will you accompany us?"

"They will set the thipdars upon us," he said, "and then we shall be killed; but—" he hesitated— "I would take the chance if I thought that I might possibly escape and return to my own people."

"Could you find your way back to your own land?" asked Perry. "And could you aid David in his search for Dian?"

"Yes."

I was for making the attempted escape at once, but both Perry and Ghak counseled waiting for some propitious accident which would insure us some small degree of success.

I had been searching about far below the levels that we slaves were supposed to frequent—possibly fifty feet beneath the main floor of the building—among a network of corridors and apartments, when I came suddenly upon three Mahars curled up upon a bed of skins. At first I thought they were dead, but later their regular breathing convinced me of my error. Like a flash the thought came to me of the marvelous opportunity these sleeping reptiles offered as a means of eluding the watchfulness of our captors and the Sagoth guards.

Extermination!

HASTENING back to Perry where he pored over a musty pile of, to me,

meaningless hieroglyphics, I explained my plan to him. To my surprise he was horrified.

"It would be murder, David," he cried. "Murder to kill a reptile monster?" I asked in astonishment.

"Here they are not monsters, David," he replied. "Here they are the dominant race —we are the 'monsters'—the lower orders. In Pellucidar evolution has progressed along different lines than upon the outer earth. The Mahars look upon us as we look upon the beasts of our fields, and I learn from their written records that other races of Mahars feed upon men—they keep them in great droves, as we keep cattle. They breed them most carefully, and when they are quite fat, they kill and eat them."

I shuddered.

"Yes, David," he concluded, "it would entail murder to carry out your plan."

"Very well then, Perry," I replied. "I shall become a murderer."

He got me to go over the plan again most carefully, and for some reason which was not at the time clear to me insisted upon a very careful description of the apartments and corridors I had just explored.

"I wonder, David," he said at length, "as you are determined to carry out your wild scheme, if we could not accomplish something of very real and lasting benefit for the human race of Pellucidar at the same time. Listen. I have learned much of a most surprising nature from these archives of the Mahars.

"Once the males were all-powerful, but ages ago the females, little by little, assumed the mastery. Finally a certain female scientist announced the fact that she had discovered a method whereby eggs might be fertilized by chemical means after they were laid—all true reptiles, you know, are hatched from eggs.

"What happened? Immediately the necessity for males ceased to exist—the race was no longer dependent upon them. More ages elapsed until at the present time we find a race consisting exclusively of females. But here is the point. The secret of this chemical formula is kept by a single race of Mahars. It is in the city of Phutra, and unless I am greatly in error I judge from your description of the vaults through which you passed today that it lies hidden in the cellar of this building.

"For two reasons they hide it away and guard it jealously. First, because upon it depends the very life of the race of Mahars, and second, owing to the fact that when it was public property as at first so many were experimenting with it that the danger of overpopulation became very grave.

"David, if we can escape, and at the same time take with us this great secret, what will we not have accomplished for the human race within Pellucidar!"

The very thought of it fairly overpowered me. Why, we two would be the means of placing the men of the inner world in their rightful place among created things. Only the Sagoths would then stand between them and absolute supremacy, and I was not quite sure but that the Sagoths owed all their power to the greater intelligence of the Mahars—I could not believe that these gorilla-like beasts were the mental superiors of the human race of Pellucidar.

"Why, Perry," I exclaimed, "you and I may reclaim a whole world! Together we can lead the races of men out of the darkness of ignorance into the light of advancement and civilization."

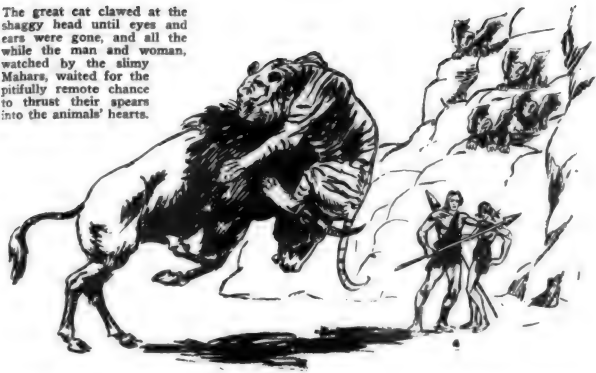
In the Arena

GHAK had entered the apartment some time before we concluded our conversation, and now he wanted to know what we were so excited about. Perry thought we had best not tell him too much, and so I only explained that I had a plan for escape.

Within Pellucidar one time is as good as another. There were no nights to mask our attempted escape. All must be done in broad daylight—all but the work I had to do in the apartment beneath the building. So we determined to put our plan to an immediate test lest the Mahars who made it possible should awake before I reached them; but we were doomed to disappointment, for no sooner had we reached the main floor of the building on our way to the pits beneath, than we encountered hurrying bands of slaves being hastened under strong Sagoth guard out of the edifice to the avenue beyond.

Other Sagoths were darting hither and thither in search of other slaves, and the moment that we appeared we were pounced upon and hustled into the line of marching humans.

What the purpose or nature of the general exodus was we did not know, but presently through the line of captives ran the



The great cat clawed at the shaggy head until eyes and ears were gone, and all the while the man and woman, watched by the slimy Mahars, waited for the pitifully remote chance to thrust their spears into the animals' hearts.

rumor that two escaped slaves had been recaptured—a man and a woman—and that we were marching to witness their punishment.

We were finally herded through a low entrance into a huge building the center of which was given up to a good-sized arena. Benches surrounded this open space upon three sides, and along the fourth were heaped huge bowlders which rose in receding tiers toward the roof.

The Mahars began to file into the enclosure. They marched directly across the arena toward the rocks upon the opposite side, where, spreading their batlike wings, they rose above the high wall of the pit, settling down upon the bowlders above. These were the reserved seats, the boxes of the elect.

Presently a door in one side of the arena wall was opened to admit a huge, shaggy, bull-like creature.

"A Bos," whispered Perry, excitedly. "His kind roamed the outer crust with the cave bear and the mammoth ages and ages ago. We have been carried back a million years, David, to the childhood of a planet —is it not wondrous?"

But I saw only the raven hair of a half-naked girl, and my heart stood still in dumb misery at the sight of her, nor had I any eyes for the wonders of natural history.

With the advent of the Bos—they call the thing a *thag* within Pellucidar—two spears were tossed into the arena at the feet of the prisoners. It seemed to me that a bean shooter would have been as effective against the mighty monster as these pitiful weapons.

As the animal approached the two, bellowing and pawing the ground with the strength of many earthly bulls, another door directly beneath us was opened, and from it issued the most terrific roar that ever had fallen upon my outraged ears. I could not at first see the beast from which emanated this fearsome challenge, but the sound had the effect of bringing the two victims around with a sudden start, and then I saw the girl's face—she was not Dian! I could have wept for relief.

And now, as the two stood frozen in terror, I saw the author of that fearsome sound creeping stealthily into view. It was a huge tiger—such as hunted the great Bos through the jungles primeval when the world was young.

Upon one side of the doomed pair the thag bellowed and advanced, and upon the other *tarag*, the frightful, crept toward them with gaping mouth and dripping fangs.

The man seized the spears, handing one of them to the woman. At the sound of the roaring of the tiger the bull's bellowing became a veritable frenzy of rageful noise.

There ensued a battle royal which for

(Continued on page 166)

New Rubber Mattress Saves Weight

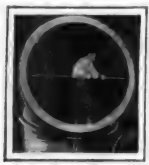
DURING a recent rubber goods exposition held in London a novel use of sponge rubber was shown for the first time in the form of a rubber mattress designed to take the place of the old time bed spring. The new mattress is placed under the regulation cotton mattress and takes the place long occupied by the metal spring.

Compactness and light weight are features which recommend the rubber mattress. At moving time it can be bundled up into a roll much more convenient to carry than the old time spring which it displaces.

The rubber sponge mattress shown above will not only save weight but will do away with bed springs entirely.

LARGEST STEAM PIPE

BELOW is shown the world's largest steam pipe which was recently completed at the south Philadelphia works of the Westinghouse Electric and Manufacturing Company. It is seven feet in diameter and is composed of sections of rolled steel which are joined together by arc-welding. It is to be installed in a large power plant and will carry 1,600,000 pounds of steam per hour at 40 pounds absolute pressure. Note the man in the elbow.



NEW BATTERY CHARGER

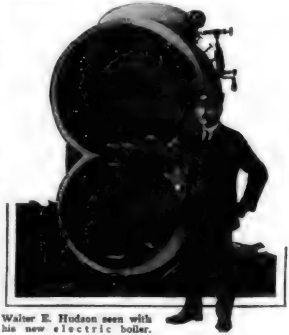
A THREE rate service station battery charger which, through use of a specially designed switch, can be made to charge batteries at three different rates, has recently been perfected by C. F. Holmes of 5116 Ravenswood Avenue, Chicago, Ill. The inventor claims that the new charger saves from 40% to 60% in electrical current and at the same time handles 50% to 70% more batteries. The larger charging capacity is expected to enable service station owners to reap larger profits, since the device does not increase the equipment overhead.

FRESH AIR CURES CRIME

WORKING on a theory held by several nationally known penal experts that one important cure for crime is plenty of clean, fresh air and light, officials of the Harris County jail in Houston, Texas, have introduced "made to order" weather in the jail for all prisoners. All air passes through a mechanical ventilating system.

ELECTRIC STEAM BOILER

SCIENTISTS have been trying for years to create an electric steam boiler which would heat railroad trains successfully, but the problem remained unsolved until Walter E. Hudson, one of the oldest conductors on the Long Island Railroad, devised a workable boiler. Recently tests were held on the new electric steam boiler invented by Mr. Hudson and it was found successful in every respect.

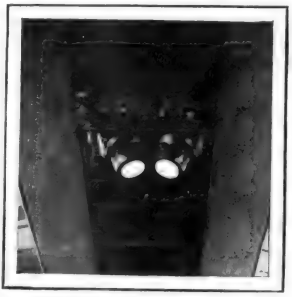


Walter E. Hudson seen with his new electric boiler.

New Air Cameras Take Stereoscopic Pictures

IN THE early days of aviation most of the aerial photographs were taken with small hand cameras carried by amateurs who simply trained their lenses on the ground and pressed the button. Today, however, aerial photography is a specialized branch of the profession, and special cameras of various types are used depending on the purpose to which the pictures may be put. A double-barrelled camera which produces stereoscopic pictures is shown in the photograph mounted in the fuselage of a photographer's plane, which also contains a laboratory in which the plates may be developed before landing.

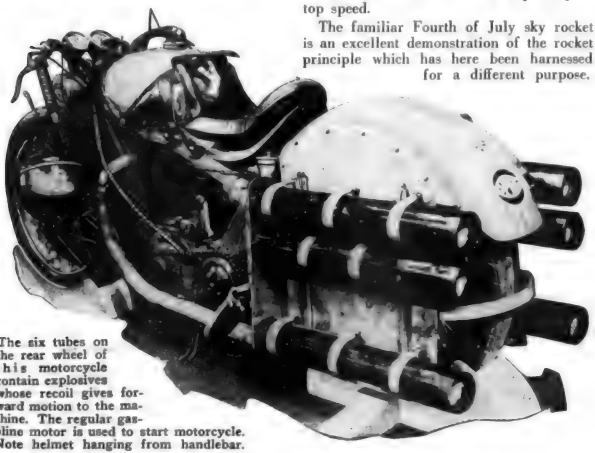
Aerial mapping is widely used for such purposes as laying out new city streets and studying distribution of population.



GERMAN MOTORCYCLE RUN BY ROCKETS

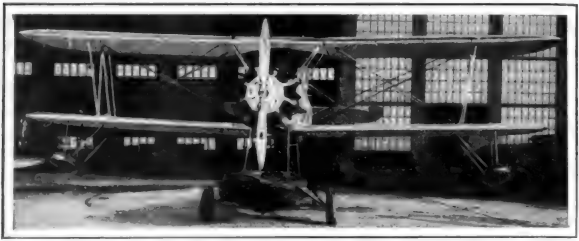
ROCKETS are the propelling force which give tremendous speed to the motorcycle shown in the photo below, recently exhibited at the Berlin motor show. It is the invention of Fritz von Opel, German motor car manufacturer who has won fame through his experiments with rocket-powered automobiles and railway cars. The six rocket tubes alongside the rear wheel act as auxiliaries to the regular gasoline motor, which is used to start the motorcycle in motion, after which the rockets step it up to top speed.

The familiar Fourth of July sky rocket is an excellent demonstration of the rocket principle which has been harnessed for a different purpose.



The six tubes on the rear wheel of this motorcycle contain explosives whose recoil gives forward motion to the machine. The regular gasoline motor is used to start motorcycle. Note helmet hanging from handlebar.

Catapulting Amphibian is New Type of Navy Plane



A NEW type of amphibian plane designed for launching by catapults from shipboard or from floating airfields has just been delivered to the Navy for testing. The plane, shown in the above photograph, is known as the Vought 02-U2. Several novel features of construction mark the plane as different from anything that has been built before. The wheeled landing gear is retractible, being controlled from the cockpit. The wheels are mounted on an axle which is split in the center, where a screw device is attached which thrusts the wheels upward, above the level of the hull. The large center float is fitted with a leather bumper on its nose to prevent damage from minor collisions. Small floats secured under the tips of the lower wings aid in balancing the plane and make sure that the ship will not be capsized by high waves. The amphibian is a type which will be used by the navy for scout work.

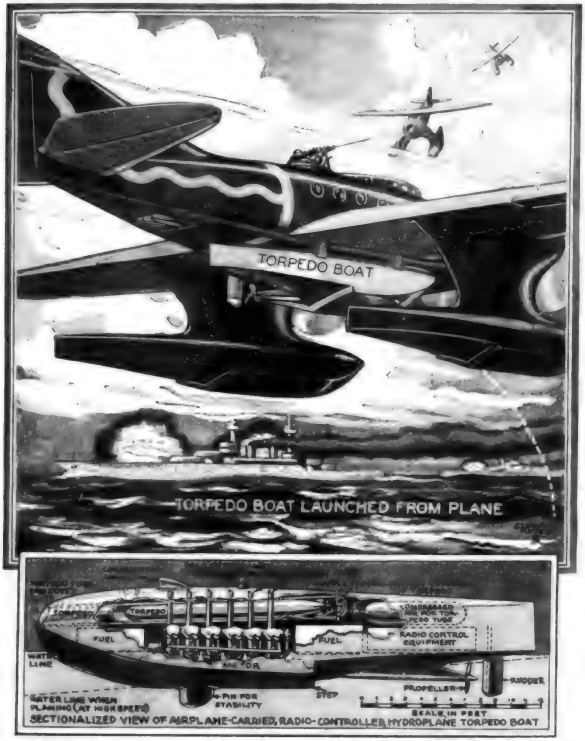
PNEUMATIC DRILL IS SURGICAL INSTRUMENT

THE FAMILIAR compressed air drill seems a far cry from a delicate surgical instrument for use in bone operations, yet Dr. W. H. Ogilvie, shown in the photo at the right, has perfected a pneumatic drill for just such a purpose. In operating principle it is not unlike a dentist's drill except that the motive power comes from a cylinder of compressed air. The instrument is expected to prove of great service to surgeons in shortening the time required to cut away diseased bony parts. It will also increase the patient's chances of recovery by shortening the strain of the operation.

SYNTHETIC MOTOR FUEL

COAL as a source of gasoline has been successfully developed on a commercial scale by German chemists in the past year. The coal is subjected to what is known as the Bergius process, which produces a completed product which cannot be distinguished from ordinary gasoline. Production of 70,000 tons was reported for 1928, with a trebled output scheduled for 1929.

Plane Drops Exploding Boat



The U. S. Navy over a period of years has been experimenting with the development of methods for launching high explosives from seaplanes. One of the latest proposals is to use ships having enough range to carry beneath them radio-controlled motor boats. The plane flies to a point near the scene of enemy operations, drops the radio controlled torpedo boat, and gains altitude beyond the effective reach of anti-aircraft guns. From this extreme altitude the course of the floating engine of destruction is guided to a sure and effective mark. Therein lies its effectiveness. The artist's description of the method of construction and operation is shown above.

MAKING A SIMPLE MAGIC LANTERN

By T. S. ASGAARD

Here's another of Mr. Asgaard's "how to build" articles which have proved so popular with readers of Modern Mechanics. This time he shows how to make a magic lantern from a camera and a cracker tin!

A MAGIC lantern which will project photographs, postcards, and colored pictures on a screen with surprising clearness of detail can be easily and cheaply made from a discarded tin cracker caddy and a camera, preferably of the open back type. A few minutes work and a few cents worth of electrical material from the ten cent store will give you a magic lantern which will reward you with a brand new type of home entertainment.

Here's the magic lantern all complete and ready for action. The camera and cracker box which are its main elements are clearly shown in the photo.

One can make a good magic lantern from an old cracker tin and one of the open back type folding cameras. The views taken from the camera can be projected full right to the border, and other views can be projected to include as much as the camera can catch.

Take a thick board, which should be heavy enough to hold the weight of the camera and the lights and the cracker tin. Then mount the cracker tin, which is the standard size container such as can be had from any corner grocer, onto one end of the board so that enough of the edge of the tin laps over to permit the hinged view holder to fall down tight when the holder is dropped.

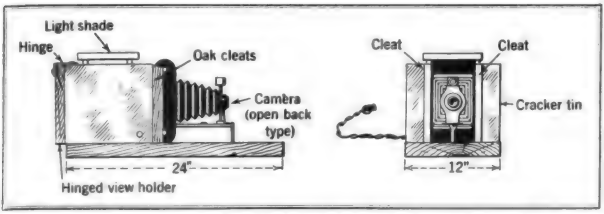
When the tin box has been mounted on the board it will be very much easier to handle, and the cleats which hold the camera to the opening which must be cut can then be put on. Use ordinary shingle nails. Put the cleats where you want them and then scribe along the tin to mark the place where they go. Then take a finishing nail and from the outside punch two holes per cleat into the can. From the inside of the can put marks into the cleats as you hold them in place. Take the cleats out, pound the nails into the place where you have marked them, and pull the nails out. Putting the cleats back into place, set other nails into the holes, and by pounding the cleats and holding a sad iron against the nail from the inside of the tin you will find that the cleats will be nailed down tightly.

Chisel out a place between the cleats for the back of the camera to fit in. The camera can be opened up, put back against the hole in the magic lantern, and taped light proof against the cleats.

Inside the lantern are two 75-watt electric light bulbs placed in ten cent porcelain sockets. The wiring is done as shown in the diagram.

The view holder is a piece of board hinged with leather strips nailed as shown. The leather makes a light proof back. The holders for grasping the views, which must be shown upside down, are shown in the drawings. Take small brass spring sheets and cut them so that the views will slip in readily. Then the backs of the cards can be slipped in under simple brass angle hooks.

The roof of the tin will have to be punched full of holes for circulation of air. Every time the door or view holder is open-



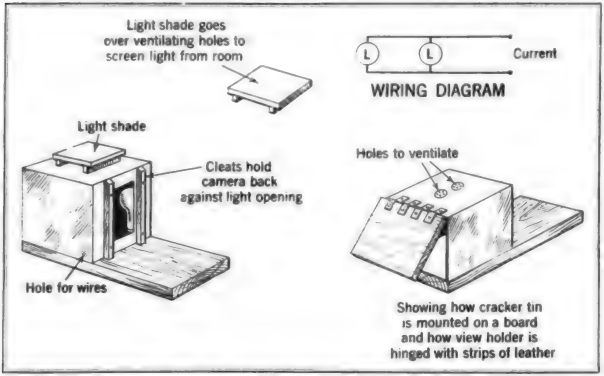
Side and front diagrams showing how the various parts such as camera, cracker tin, cleats and view holder are mounted on the base panel.

ed to insert a view the air rushes in and out through the holes, cooling the intense heat of the 75-watt lamps. You must be sure to have these ventilating holes. The light will escape from the top of the lantern unless you use a shade as is shown in the drawing.

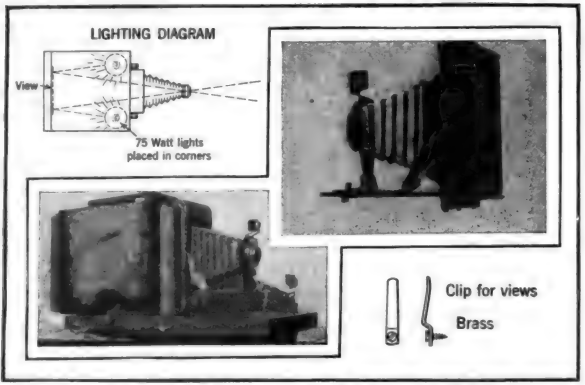
The cameras which can be used for this kind of a magic lantern must be of the focusing type. A box camera can be used provided the back part of the box is placed in a bellows which is lightproof to permit you to slide the camera lenses up and down to get a focus.

The cord which is used for the wiring is the green braided kind which can be bought at the ten cent store. The hole in the cracker tin must be insulated with tape or a porcelain insulator.

To operate the camera, just place the views in upside down. Turn on the light, and fix the time exposure stop on the camera so that the lens is open. Then focus the picture. You will find that if you open the stop wide a bright picture will come upon the screen, and if you focus it down fine there will come a dull but very sharp picture.



Wiring diagram and further details are given in the above sketches. Be sure to punch the ventilating holes in the top of the cracker tin as shown in order to prevent the lantern from "heating up."



To focus the magic lantern, move the lens section of the camera until a clear picture is thrown on the screen. The upper picture shows the open back type of camera which is most easily adapted for use in the magic lantern.

The lights may be so bright that they shine onto the screen. If that is the case, just put pieces of dark blotting paper or a piece of tin around them so that all of the light is reflected on the picture and not on the lens direct.

Color scenes and postcards can be shown and will come out in full color on the screen. An ordinary sheet will make a good screen. If the lantern gets hot there will be danger of damaging the camera. An electric fan will keep it cool. Use lamp-black mixed in turpentine to paint it. The cost of the lantern made by the writer, shown in the pictures, was about an hour's time and fifty cents for electrical supplies at the ten cent store.

If you have a room at home which is equipped with sliding or folding doors you will be enabled to present your pictures more effectively and put on "shows."

Let the doors stand between the lantern and the audience. Keep them far enough ajar so that the beam of light barely misses the edges. Then the light of the camera and lantern will be confined to one room and the audience may enjoy the pictures projected through onto a screen in front of them.

It is a good plan to turn the lights off every few minutes so that the globes may cool. The lights generate considerable heat, and the camera bellows may suffer if kept too long in contact with the heat without cooling.

NEXT month comes a great article on how to build a small but practical 13-foot cruising yacht which will give you many hours of sport next summer. This tiny yacht is an excellent sailer. It has a cabin, bunks, and all the essential accessories of its large size sisters. It was designed by Weston Farmer, naval architect. Watch for it in the April issue!

Airplane Camping Tours

Englishmen are great sportsmen, and have excelled in the realms of rugged play such as hunting, cruising and deep sea fishing. The latest wrinkle is the practical use to which a Westland Widgeon has been put. This monoplane is of the light two-seater type and has been fitted with space in which a tent, a folding boat and all the usual comforts of camp life can be stowed.

Week-Ending in Your Own Sport Monoplane!

CRUISING is one of the favorite sports of red blooded men the world over. What, then, could be more alluring than the prospect of hopping off in your own private light plane, flying to the spot your heart has a special fondness for, and spending the week ends in a lazy way? And to be assured that a return to civilization could be accomplished in an hour or so?

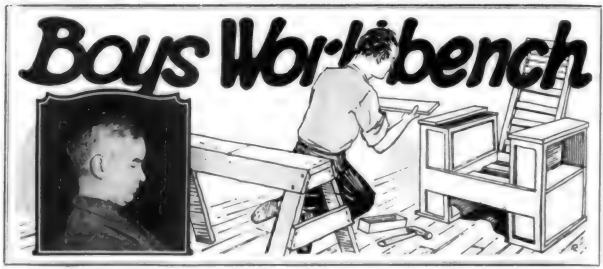
The day of light plane cruising is here, if we are to take the methods employed by an Englishman as a guide. Mr. H. Brooklyn, who owns the Westland Widgeon light monoplane pictured here, has made many camping trips with his outfit. He says of a recent trip across Europe:

"My longest trip to date was on an attempt to reach Venice to see the Schneider Trophy race. I left England the day before the race, but owing to bad weather I had to turn back at Mount Cenis Pass. On this run I reached 13,000 feet with six hours' petrol on board and actually spent 70 minutes doing 30 miles. My machine carried eight hours' petrol and altogether did 1,200 miles in three days, totalling 19 hours' flying time.

"My equipment includes a small 7-ft. by 5-ft. tent, and a collapsible rubber boat, which plays the dual part of a bath by day and a bed by night. Some bedding, food, a stove and cooking utensils complete the outfit."

The Westland Widgeon which Mr. Brooklyn uses is a monoplane of the two place tandem type. It is equipped with a radial motor,—a 60 h. p. Genet. The cruising speed varies between 65 m. p. h. with 2 people up, and 80 m. p. h. light. This is at 1,550 r. p. m. and as the motor is capable of 2,025 "all out" Mr. Brooklyn has a snappy little ship in which to do his camping flying.

This type of cruising opens up great possibilities, especially for American young men, for it allows them to enjoy in a few hours' time the rugged American out of doors which so often is inaccessible by train or bus without much inconvenience.



Edited by A. NEELY HALL
Author of "The Boy Craftsman," etc.

Make This Easy Chair from a Packing Box

THIS month Mr. Hall's picture appears at the head of his department for the first time, and in another section of the magazine he writes an interesting introduction of himself for the benefit of young readers who are meeting him for the first time. After you have read it, go down to your workshop and begin to make the study chair described below.

THE big easy chair shown in the photograph stands here in my studio, and, although it is made of boxes and box boards, with cushions stuffed with excelsior, it is quite the most comfortable and the handiest chair I ever had. For study purposes, the right arm provides a broad surface to write upon, the left arm supports an opened book; or, if you are left handed, the left arm provides the writing surface. A shelf below each arm holds a dozen or more books—your school books, handy books, and favorite story books. Here you have them at your finger tips. And below each book shelf there is a secret safe, reached by removing the shelf, in which to keep lesson-papers and such other papers as you wish to file away. Another feature which suggested itself after I finished the chair, and which you can add if you wish to, is a receptacle for stationery immediately below one arm, which would be reached by raising the arm, the arm to be hinged. You would have no difficulty in adding the arm receptacle.

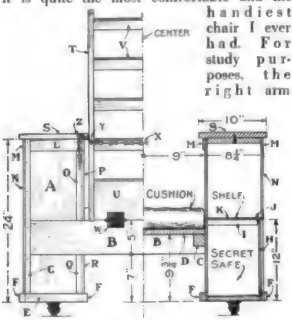


Figure 1. One-half back view and one-half cross section of the packing box study chair.

This is an excellent reading-chair, also having a reclining back of the Morris-chair type that can be adjusted to half a dozen heights. Because I used only such materials in this chair as you boys can procure, and because the construction is very simple, there is no reason why every reader cannot own one just like it.

Figure 1 shows the completed chair, one-half of the drawing being a back view, and the other half of the drawing a cross-section. The only difference between the back view and the cross-section is that the latter shows the rear portion r e m o v e d. just as though it had been cut away with a saw, exposing the inside of the book-case and safe, and showing the construction of the chair seat. Figure 3 shows an end view of the chair.

Each part is lettered in Figs. 1 and 3, and you will find the parts correspondingly lettered on the detail drawings of Figs. 4 and 5. The lettering will aid you in locating the parts and will simplify the work of assembling.

Two boxes for the chair ends, boards from several other boxes, and some ⅞-inch stock, will be needed. The boxes for the chair ends must be uniform in size. Those used for my chair measured 8½ inches deep, 20 inches wide, and 24 inches long (A, Fig. 4). It is not likely you will find boxes of exactly this size, but you ought to be able to get two pretty close to it. Try a paint store. That is where I bought mine. If you can get nothing this size, but find two l a r g e r ones, t a k e them and cut them down.

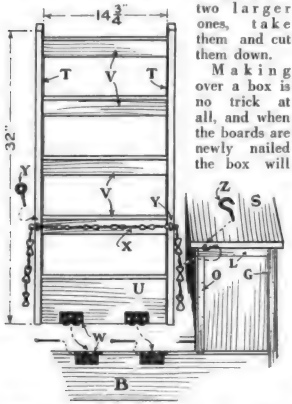


Figure 5. This diagram shows the method of constructing the adjustable back for the chair.

M a k i n g over a box is no trick at all, and when the boards are newly nailed the box will

The Study Chair Ready for Use!

Figure 2. This is what the finished study chair looks like. You'd never guess it was made from old boxes!

be stronger than before the alteration. The dimensions on the drawing are for a chair built upon boxes of the sizes mentioned above. You may have to alter some of the dimensions to suit your boxes.

Figure 4 shows the chair in its first stages of construction. Stand the boxes on end, bottoms in, and 18 inches apart, and connect them with the front and rear rails B, setting the rail strips so their upper edge is 12 inches above the floor (Fig. 1). Cut the strips short enough to allow for a space ¾-inch wide at each corner for strips G (Fig. 4). Spike a 2-by-2 inch cleat to each of the box bottoms, 9-¾ inches above the floor (C, Fig. 4), and cut five slats to fit across them (D). Nail the slats to cleats C, and drive nails through rails B into the edges of the front and back slats. Before fastening corner strips G in place, cut and fasten strips E and F around the base of both boxes. These base strips may be ¾-inch square. Stand corner strips G upon the base.

The book-shelf is placed on a line with the upper edge of rails B. Nail a pair of cleats I to the inside of the boxes to support the shelf ends. Make the front to the secret safe in one piece if you can get a board wide enough (H, Figs. 1, 3 and 4). Fit this between the box sides. Before fitting the shelf boards (J and K, Fig. 4),

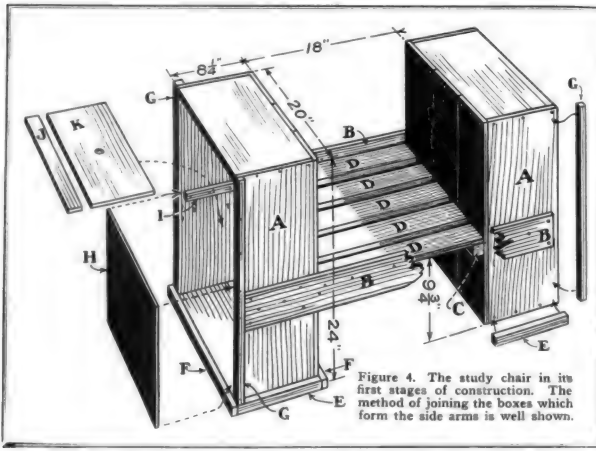


Figure 4. The study chair in its first stages of construction. The method of joining the boxes which form the side arms is well shown.

finish trimming the box edges. Strips L and M, forming a band around the tops of the boxes (Figs. 1 and 3), should be 1⅜-inches wide by ⅞-inch thick. Strips N, O, P, Q and R may be laths planed smooth. The lapped strip must be planed off enough to allow for the thickness of the strip lapping it, so the corner margins will be equal. It is best to tack each pair of corner strips together, then fasten them to the box. The strips will conceal the unfinished corners of the boxes. When strips N have been nailed (Fig. 3), shelf strip J can be fitted in place. Nail it to the shelf cleats so its outer edge is flush with strips N (Fig. 1). Cut shelf board K to fit loosely, because it is to be removable, and bore a finger-hole through its center so you can lift it out easily (Fig. 4).

Fig. Side view of the study chair.

The chair arms are 10 inches wide and 24 inches long (Figs. 1 and 3). Cut them out of a ⅞-inch board if you can get one. If the board is 9½ inches wide, as some 10-inch boards are cut, it will do. Do not nail the chair arms to the boxes, but screw through the boxes into their under side. Then there will be no holes in the arms to putty.

Figure 5 shows a detail of the chair back. The side rails (T) and four of the cross-rails (V) measure ⅞-inch thick and 1¾ inches wide. If you can get a 1-by-2-inch strip it will save you the work of ripping out the pieces. The bottom cross-rail (U) is 5 inches wide.

Hinge the back to rail B, as shown. Loose-pin hinges (W) were used on my chair, but they are not necessary. The reclining chair-back is supported by a piece of hammock-chain 3 feet long (X). This

is fastened to rails T with screweyes (Y), and the chain ends are slipped over screw-hooks (Z) screwed into the chair-arm ends.

Now all is ready for the casters. Buy a set with plates that fasten on with screws. Figures 1 and 3 show the positions for them.

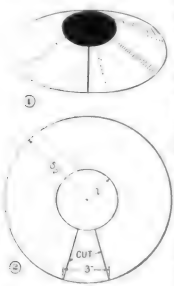
The chair should be given two coats of wood-stain. My chair is finished a fumed-oak color, which looks well and is dark enough to conceal printing and other box blemishes. It is well to putty cracks and nail-holes. After the stain has set, apply a coat of shellac.

You had better ask mother to help with the cushions, because they must be made to fit, and that requires exactness in measuring, cutting and sewing, which mother understands all about. Two strong sacks such as poultry-feed is sold in, can be used for the cushions, and after these have been stuffed they can be covered with cretonne. The cushions can be stuffed with excelsior. Dampen the excelsior before filling the cushions, then it will pack in compactly. If mother has an old mattress to give you, it will furnish more than enough ticking and filling for the pair of cushions.

CARDBOARD GOLF HOLE

A PUTTER, a golf ball and home-made holes like the one in the photograph, are all that are required for indoor golf, a game that all of the family will enjoy.

Make the holes of cardboard of the weight used in boxes. Lay out a disk of the diameter shown in Fig. 2, with a 1-inch center hole, and a 3-inch segment to be cut from the side. Then cut it out, bring together the edges left after removing the segment, and fasten by gluing the segment over the joint, underneath. Clamp with several spring clothespins until the glue has set.



One hole is enough for putting practice but you can use as many more as your playing space will permit. With one hole, place it to one side of a circle marked out with a clothesline, and divide the circle into twelve parts, like a clock's face. Mark each division point with a cardboard number. This is the lay-out for clock golf, a game in which the object is to hole out from the circle, from numbers 1 to 12, in the fewest number of strokes.

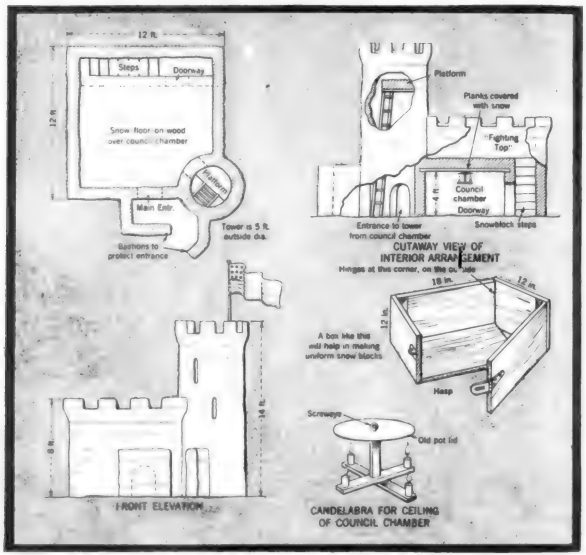
Play Golf Indoors this Winter!

COLORED FIRE

To make smokeless vari-colored fire, take barytes or strontium, bring to a glowing heat in a suitable dish, and add shellac. The latter will melt at once and can be mixed in with a spatula. After cooling, pulverize. One may also add 2½ per cent of powdered magnesium to add to the effect.

An INVULNERABLE Snow Fort

By HI SIBLEY



This handsome snow fort is easily built by following the above plans.

A BOY'S childhood is not complete until he has helped build a snow fort and has enjoyed the thrills of snowball assault, siege and defense.

To make a workmanlike job of your snow building, first construct a snow-block mould as shown in the diagram. This device permits packing snow much harder than in the usual rolled snowball and consequently it will withstand a thaw.

First mark the outline of the walls on the ground, and then build up with the blocks, tier upon tier. For the round tower walls cut the block ends diagonally and round the outer edges to follow the circle. When the fourth tier is completed in the main structure, lay boards across for the roof of the council chamber and cover the entire area for solidity and appearance. The tower platform is made in the same manner, but with an opening left for the top of the ladder.

When you have reached the next to last tier of main and tower walls, set the blocks to overhang about four inches and shave off the corners to make them flush with the lower wall. Each night—provided the thermometer registers below freezing—turn a fine spray over the walls with the hose. Continue this for several nights, and your fort will assume a beautiful translucent glaze.

Featherweight Hydroglider Develops Great Speed

AFTER some six years of experimenting, J. Davies, an engineer of Dudley, England, has perfected a light hydroglider which, with a small 6 h. p. engine is able to do 25 miles per hour with ease. This is phenomenal speed for a small engine and is made possible by the streamlines of the hull, the fleet design of the bottom, and the light weight of the whole boat. Notice that an air rudder is used for steering, so that there is nothing on the bottom of the boat but paint.

Because of the extensive canal systems and small streams which form a water network throughout Europe, a peculiar type of water craft has been evolved to keep pace with the need for speed. Shallow waters are dangerous to craft driven with the usual screw propeller, and experimenters have turned toward air propelled boats. Farman of France and Saunders of Great Britain, have been among the leaders in the development of "free bottom" craft.

WILKINS USES WOODEN PLANE AT POLE

THE photo at the right shows one of the two Lockheed Vega monoplanes which Capt. Sir Hubert Wilkins is using in his exploration work at the South Polar ice cap. This is a ship identical with the one which Wilkins used in his Alaska-Spitzbergen flight last year. It differs only in that it has been equipped with floats and will be enabled to rise and land on the "briny."

Due to the fact that the Vega is largely built of wood, having wooden wings and a pressed wooden fuselage, it deteriorates less rapidly from weathering than would a fabric ship. Metal ships, it has been found, are more difficult to heat and to repair. For these reasons, Wilkins favored this type of ship for his Polar expedition, which at present is operating from Deception Island in the Antarctic, establishing weather observation posts about the Polar ice rim.

The Lockheed Vega which Wilkins is using on flights on the South Polar Ice Cap has a wooden wing and a wooden fuselage.

Women Enter New Trade as Test Auto Drivers

EVEN the highly specialized field of test driving in the automobile industry has been invaded by the modern woman. A French manufacturer has found that women are very satisfactory as testers because they are careful and have a sharp sense of hearing. The chief problem of test driving is the location of motor troubles. Any vibration noise that develops in the first few miles of service must be traced to its source.

The three women in the photo are conducting special tests on the private track of a French factory. Note the absence of windshield and fenders. The chassis is stripped down so that all parts are accessible to the tester. In order that the production output of the factory may be high at all times, speed in the track test is essential and women have shown that they can perform this work efficiently.

NOVEL DOG AMBULANCE FOR SICK CANINES

CARING for sick dogs is one of the duties of the Berlin Society for the Prevention of Cruelty to Animals. In order that sick animals may be hustled to the "dog hospital," the society had a specially designed truck built for that purpose. The body of this ambulance is divided into several compartments or cages where the patient may be placed while being transported. It may be noted from the photo that the compartments are large enough for the biggest dog. Each cell has its own effective ventilating system, and beds of straw assure the canine passengers a comfortable ride to the hospital.

A side view of Berlin's specially designed dog ambulance. Above is a dog in one of the compartments.

Small Outboard Boat is Adapted for Fire Service

BY INSTALLING a gasoline pumping outfit in a small outboard boat, as shown above, the Boston Fire Department made a valuable addition to the harbor fire protection service. The gasoline motor drives a centrifugal pump that is capable of throwing a powerful stream of water a long distance. The boat is driven by an outboard motor of the conventional type.

Being small and very maneuverable, this new "Mosquito" fire boat can be dispatched to small fires making it unnecessary to call on the big fire boats.

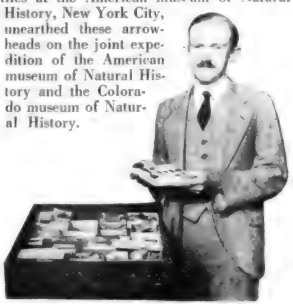
ENGINEERS SEARCH FOR METEOR

AMERICAN engineers have organized a company to dig for the famous meteor that is supposed to have plunged into the earth in Arizona, leaving the great cavity called Meteor Crater. There have been two previous attempts to unearth this meteor. The first, which took place in 1903, failed for lack of funds, while the second was abandoned when the machinery became disabled.

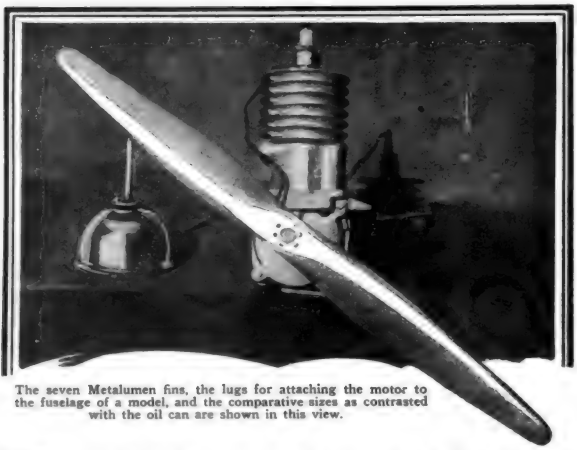
The present shaft is being sunk at the rate of seven feet per day. It is expected that fifteen months will be required before the excavations can reach the meteor mass that is presumed to lie about 1,200 feet beneath the surface.

ANCIENT ARROWHEADS DISCOVERED

ARROWHEADS made by human hands were unearthed recently at Folsom, New Mexico. They were found alongside the remains of a prehistoric bison, which tends to prove that man inhabited this continent some 15,000 years ago. Dr. George Simpson, assistant Curator of Fossil Reptiles at the American museum of Natural History, New York City, unearthed these arrowheads on the joint expedition of the American museum of Natural History and the Colorado museum of Natural History.



Dr. George Gaylord Simpson is shown above with some of the prehistoric American fossils that he has gathered, proving that ancient man lived in America 15,000 years ago.



The seven Metalumen fins, the lugs for attaching the motor to the fuselage of a model, and the comparative sizes as contrasted with the oil can are shown in this view.

The DYNAMIC MODEL AIRPLANE ENGINE

by GILBERT MICKELSON

This description of the design and the merits of a little air-cooled model engine will serve as a guide in machining and building it!

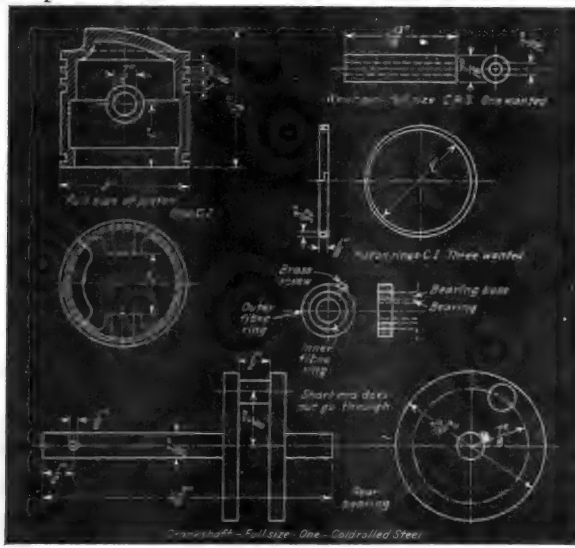
THE chap with a little workshop in the cellar, attic, shed or garage has a companion whose company he can always enjoy. It is a place where he can go to relax after a day's work; a place where quiet moments can be passed making things.

The friends he makes there are the children of his own creating. The engines and toys he fashions are firm friends or castaways according to the way they fulfill the expectations of the man who made them.

Now some of you Modern Mechanics readers are no doubt just beginning to feel the friendliness that exists between a man and his workshop and the things he creates there. And because I have met a firm friend in the little air-cooled 1 h. p. airplane engine produced by the Dynamic Mfg. Co., of First National Bank Bldg., Chicago, I want to introduce you to this fine little design and point out the remarkable features of its design so you will appreciate the quality which I found in this product.

In the November issue of Modern Mechanics there appeared on page 135 a picture of a diminutive air-cooled gasoline engine which was said to be capable of driving a rather large model airplane. The editor told me I had better get acquainted with the engine and pass along to the hundreds

Blueprints of Crankshaft and Con Rod Details



This blueprint shows full dimensions for the crankshaft, piston and timer details and will serve as a guide for the making of patterns and the machining of castings. Of course, if Dynamic parts are purchased they may be had in any stage of completion and dimensions will be unnecessary. Crankshaft on present models has been improved to better compression.

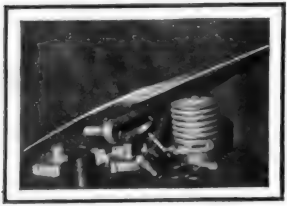
who were intensely interested in this little motor some of the details. So I purchased an engine, set it up, and ran it.

And, my, how it does go! But that's another story—

The motor is a three-port two cycle engine of 2 ins. bore by 1¾ ins. stroke. It is made of an aluminum alloy which has been specially developed by the Dynamic Mfg. Co., and which is called Metalumen. For this reason the motor weighs but 5 lbs., and it is my advice that while the drawings shown herewith are complete enough to enable one to build one's own patterns and machine one's own engine, it is better for you to purchase your castings from the Dynamic people in Metalumen. They can furnish you with a complete set of castings in the neighborhood of ten dollars, and a completely finished engine for less than you could build the patterns. Further, there are refinements in the engines they are now producing which are not shown in the drawings that accompany this article. For instance, the base is filled with the crank blank, and there is no tail to the crank shaft, so that there is no need for a split con rod bearing:—the base compression is thus raised.

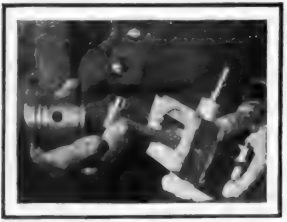
The cylinder is cast in Metalumen and is ported as the drawings show. The fins are absolutely sure cooling and are ample to

Steps in Assembling



The cast prop, the carburetor, crank, cylinder, base halves, connecting rod and piston rings are shown here. All parts which go to make the engine are pictured.

This shows how one of the improved crankshafts and con rods is placed into the front half of the base in the first step in assembling. Note base is machined inside.



Next the rear half is bolted on, the wrist pin and cylinder installed. See the hole for pinning the prop in the crankshaft, also the extension in the bronze bearing for holding the timer in place. The comparative size of the piston can be seen.

care for the requirements of the motor. A boss is cast in the head through which a ½-inch ordinary Ford spark plug is fitted. There are four base bolts consisting of No 5-20 machine screws. These are screwed into the cylinder from beneath.

The turning and boring of the cylinder is an ordinary lathe job, and can be done in any lathe that can swing 3½ ins. clear. The base is faced, mounted on an angle plate; the plug hole drilled, the boring bar does its cutting, and the plug and base bolt holes are then threaded.

One of the best features of the Dynamic design is the fact that each base piece is like the other. Four 5-20 machine screws hold the base together, and with an ordinary paper gasket, set in quick drying Duco, the base is compression proof.

The piston is of clear grain grey iron, and is about the size of an ordinary hen's egg, or so it feels to the hand. The casting of it and the making of patterns for it would be quite a job. That is one reason I recommend buying Dynamic parts.

The wrist pin supplied is a finely finished piece of steel ground to a mirror finish. It is hollow, is about 1¼ ins. long, and floats free in the piston. There is a slight taper fit. The diameter of the pin is ⅜-in.

By cleverly using bronze for the entire connecting rod, the need for inset bronze bearings was done away with in this design. This practice is thoroughly sound, as the added weight of the bronze rod is a bare ounce or no greater than would be the case with any other material. Aluminum would weigh less but I should not like an aluminum connecting rod.

The facings and drillings for the tiny manifolds on the exhaust and carburetor ends of the engine can be done with a file or a small hand shaper. Shaping it is best unless you are an expert filer. The 3-40 A. SM. E. screws are placed and tapped according to the blueprints.

You see, there are only six parts to the entire engine, so there is not a great deal which can be described.

The piston machined, the two halves of the base done, the cylinder and the connecting rod cared for, there remains nothing but the crankshaft and the timer and the bearing and the propeller.

Let us work backwards. The propeller you see in the photos is 2 ft. in diameter by 1 ft. pitch and is cast in Metalumen. There is a $\frac{7}{10}$ hole drilled through the center to

accommodate the crankshaft, and through the blade axially another free hole which allows the prop to be pinned to the crankshaft. It is not necessary that the propeller be cast in metal. A wooden prop would be much lighter, but should you intend to use the engine in a large model airplane remember that the metal prop would be liable to less damage than the wooden one. If you have ever flown model airplanes you will know that one of the biggest causes for breakage is the haphazard landing of the model. This often breaks up the one thing which causes the model builder the most time. That is the propeller. The Dynamic design weighs about a pound and is of the modern tooth pick type.

The timer is ingenious. It is a piece of brass running from the propeller over a screw placed in a fiber collar. This completes the ground circuit and is light, efficient and cheap. The drawing in Figure 1, explains its construction better than a hundred words could. Some experimenting with the timing will have to be done before you can get the engine to run at the top speed.

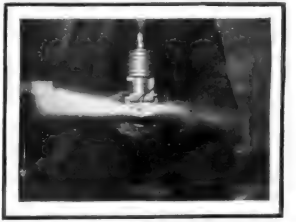
It might be better if you would devise some way by which the spark could be advanced or retarded. If you run the engine at its topmost efficiency you will find that the spark must be timed to fire at a trifle before the piston reaches the top dead center. If the timer is set this way there will be difficulty in starting the motor. Probably the best way to remedy this is to start the motor against compression. The trailing side of the timer wiper could then be made long enough to catch the piston before it went over top dead center. This would kick the motor around in the opposite direction and it would have enough force to carry the piston past the early spark on the first two or three explosions.

The present Dynamic crankshaft differs from the one shown in the drawing. The one shown in the photo shows how only one bearing (with lessened possibility of base compression leakage) is now used. Instead of having the throw of the crankshaft attached to a tail shaft as in most engines, there is a sort of flywheel which is like half a flywheel in a motorcycle engine. Over the crankpin which is put in built up fashion in this crank disc is the con rod as shown by the pictures. This saves the need for fitting the lower bearing of the con rod. All that has to be done is to drill the

Steps in Assembling

The next step in assembling the motor is the placing of the cylinder. The rings are put on the piston and the cylinder smoothed with oil so the assembly will "worry" together.

Showing the completely assembled motor with the exhaust port to the left. In the improved Dynamic motor the timer is mounted on the bearing boss shown.



Put! put! put! Kicking over a few on her own lungs. The completed motor weighs but 4 to 5 lbs. and will develop a full horsepower at 2,500 r. p. m. The man in the photo, who seems to have been decapitated, is foolhardy in holding the motor. Mount it firmly and treat the prop with respect.

Here's one of the Dynamic motors in service on a collapsible rubber boat. As auxiliary power for one of these craft the little motor described in these pages might become of widespread use.

7/16 hole in its lower end and slip it on as shown in the photos. The inside flywheel or disc makes less space for the gas to compress, and accordingly there is more snap and ping to the compression as it is transferred from the base to the cylinder by the uncovering of the ports.

The new idea in crankshafts undoubtedly adds a great deal to the speed and power of the engine.

But I said we'd look over some of the good points of the engine from the engineering standpoint, so you'd appreciate this little engine and make a firm friend of it. So here we'll pause and look over the mechanical credentials of the motor, adding a few notes of our own on small engine design.

In the first place, understand that the motor is of the two-cycle type. This means that it fires every revolution and is capable of running as well one way as it is of running the other.

Secondly, the stroke has been kept less than the bore. This makes for a high speed engine. Thirdly, the cylinder and parts which are of the greatest bulk have been cast in a light alloy. This is good practice and shows forethought.

The porting of the motor and the arrangement of the carburetor intake shows good judgment, because the air behind such a motor is traveling the same way the motor is. If the carburetor were placed to one side, or into the propeller blast there would be difficulty in keeping the mixture even, to say nothing of hard starting.

On the Dynamic carburetor there is no air adjustment. The engine is started by holding the hand over the intake to choke it, and is withdrawn once the motor takes hold.

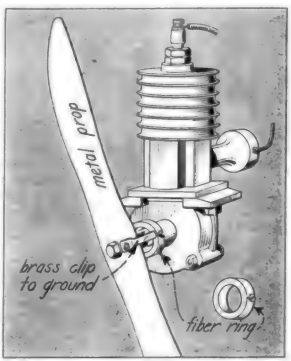
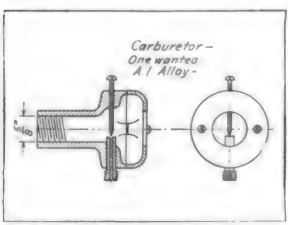


Fig. 1. This shows how the timer is mounted on the end of the motor. A brass sheet makes contact with the nut on the timer.

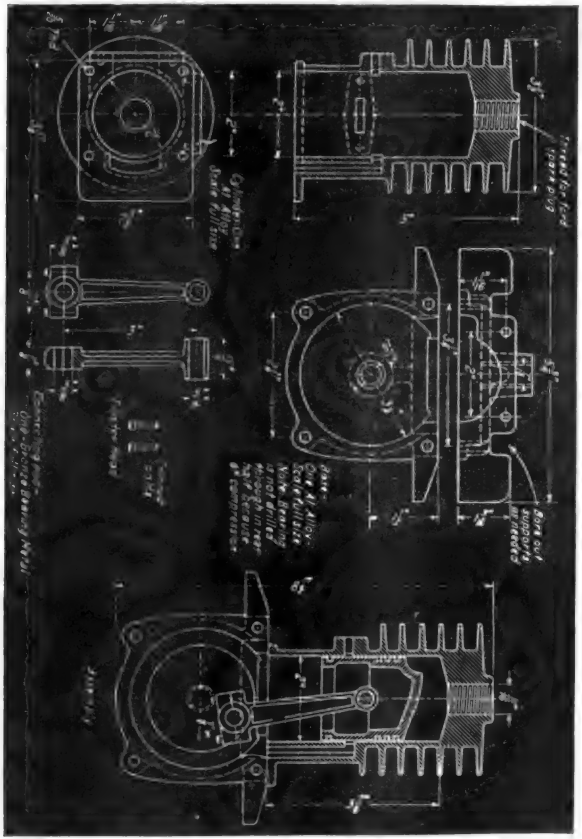


Finally, just to show you what this engine is capable of as a workshop friend, let me show you what it has done.

It has driven a boat such as is shown in the cut at a speed of seven miles per hour. It can pull a 140-lb. man better than ten miles an hour on a bicycle. With a shield around the propeller it makes a most safe form of engine for propelling a pushmobile.

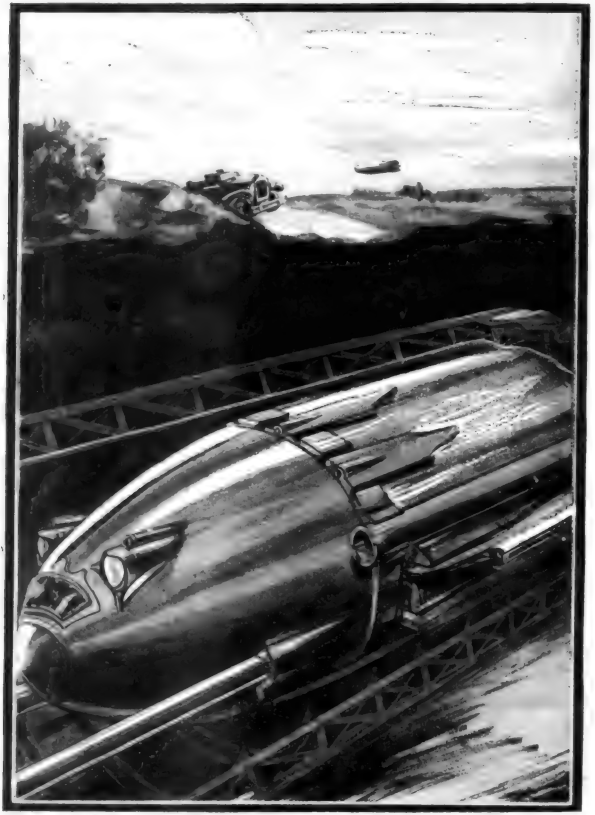
It is a good motor, a good worker and a good friend!

This One-Cylinder Engine is Dandy for Driving a Boat or Bicycle



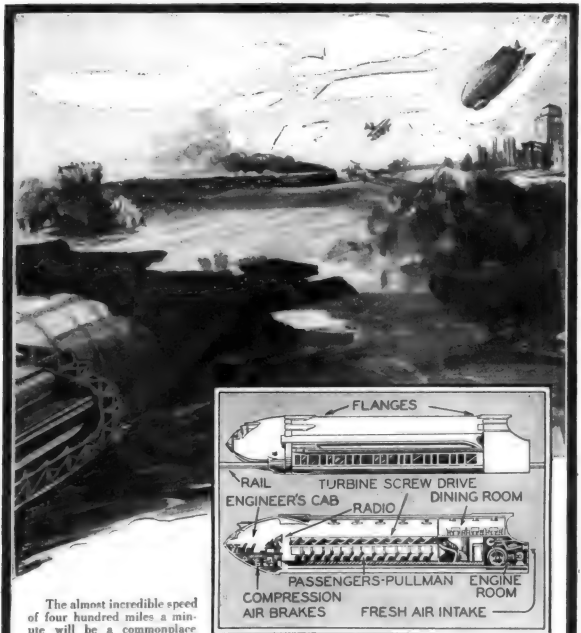
The cylinder, the two base halves, the crankshaft, the con rod, wrist pin and piston are the major parts in this simple, well designed engine.

Vacuum Tube Railway to



Above is the artist's conception of the 400-mile-a-minute vacuum tube railway proposed by a Los Angeles engineer. It is based on the familiar principle employed in the change-carrying boxes commonly employed in department stores.

Travel 400 Miles a Minute

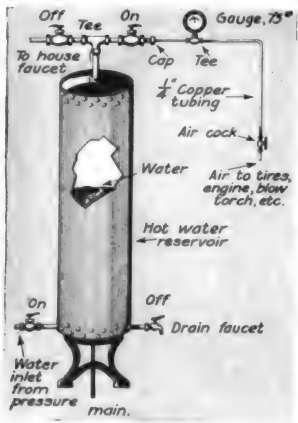


The almost incredible speed of four hundred miles a minute will be a commonplace rate of travel in the future if the novel vacuum tube railway designed by Bertram Longworth, of Los Angeles, proves practicable in service. That there is nothing at all fantastic or impossible in the design of this railway, as illustrated by the drawings herewith, is demonstrated by the fact that the vacuum tube method of carrying money and change is an accepted procedure in all up-to-date department stores.

Mr. Longworth proposes an underground tube through which a great shuttle accommodating 150 persons will slide, propelled by air pressure created by pumping stations every hundred miles along the route, which create a vacuum in front of the car. A constant spray of oil in front of the shuttle car will lubricate its pathway. Seven miles per second, or 420 miles per minute, is an entirely feasible speed over a straightaway course.

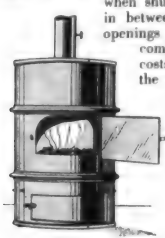
Details of the interior arrangement of the vacuum car are shown in the inset above. The shuttle would slide on rails of special alloy which would keep it on its course without twisting about in the tube due to the tremendous speed at which it would travel.

Making an Air Compressor from a Water Boiler



PAINT DRUM STOVE

WHEN the need for a cheap stove presents itself this little idea will be worth while. First get a steel paint drum. Any welder will cut a round hole in one end for the stove pipe to be inserted. Two holes are cut in the side, one above the other, the lower serving as a place to remove ashes, and the upper for putting in coal. Curved doors may be made to close these two openings, small chunks of metal being welded on to keep the doors closed when shut. A grate is put in between the two door openings and the stove is completed. The grate costs about $4.50 and the cutting and welding will cost around $7.00. The entire stove shouldn't cost more than $13, and it will be found to give excellent service during the coldest weather.



THE water reservoir which is part of the furnace system in most homes will make a good air compressor with a few simple changes in the tees and faucets. To make the compressor all you need is a tee for the top of the boiler, two extra shut-off faucets, a nipple and a cap, together with a length of one-fourth inch copper tubing. A pressure gauge can be picked up in any pawn shop for a dollar or two. When put together as shown in the drawing the compressor will be complete.

Shut off the water in the house at the main meter. Drain the water from the boiler. Then take off the nipple and elbow at the top and put in the tee hook-up with the two shut-off valves in. Put in between the main meter shut-off and the boiler another shut-off cock as shown at the bottom of the boiler opposite the drain faucet. Turn off the cock at the top of the boiler which goes to the hot water faucets upstairs. Run the copper tube line to your workbench or garage. Solder where it is inserted into the one-fourth inch hole drilled into the cap at the top of the boiler where the second shut-off cock is. Put in the gauge to tell how much water and air is in the tank.

To compress air, just turn on the water main, shut off the drain and the faucet to the house, open the one to the air line, and as the water rushes in you will find about fifteen cubic feet of air. The water pressure will be about seventy-five pounds in most cases and the air pressure will be the same. Shut off the water to keep it from rising, and you have a tank full of compressed air which will blow up a full set of balloon tires. To furnish hot water to the house, shut off the cock leading to the air line, open the other one, turn on the heater, and the boiler will work just as it did before you made an air compressor of it.

TO REMOVE PISTON RINGS

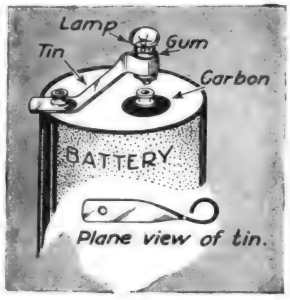
EVER had a hard time trying to remove a piston ring from a piston? Here is an easy way that works to perfection. Put a piece of rag under each end of the ring and then take hold of the two pieces of rag, one in each hand, and spring the ring open and off. It takes but a few seconds to remove a piston ring in this way and it will do it without damage to the piston.

Strip of Tin and Battery Makes Handy Flashlight

MADE from an old strip of tin and an ordinary flashlight bulb, this improvised flashlight will no doubt come in handy on camping trips or when the car breaks down. It can be made in less than a minute with an ordinary pair of tin snips and a piece of tin.

Take a piece of tin as shown in the drawing, cut it to the shape shown, and then bend one end so that the bulb will fit into it. Fasten the bulb to the tin with chewing gum or paraffin from a candle. Be sure that the tin is in contact with the jacket of the bulb. Then snip into the other side of the tin so that the negative side of the battery will screw down on the tin. By arranging the tin so that the tip of the bulb will hit the carbon center, the bulb flashes on when the tin is depressed. One dry cell has as much current as the ordinary flashlight battery.

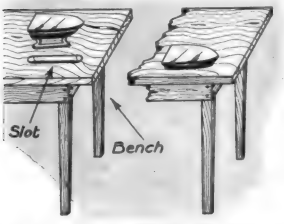
Of course the flashlight lacks a reflector and therefore does not have the power of regular lights, but it will prove to be a very effective little device for emergency use, and one whose simplicity makes it easily constructed.



Dry cell, tin and bulb make this emergency flashlight.

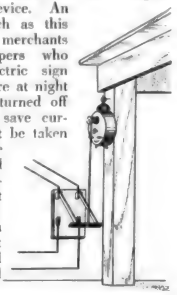
EMERGENCY ANVIL

A SMALL anvil which frequently comes in handy around the home workshop can easily be made from an old flat iron which is mounted in a corner of the workbench as shown in the diagram below. It is very simple to make; all that is necessary is a slot cut through the table top through which the handle of the flat iron projects, leaving the flat bottom resting on the table top ready for use. When not in use it is a simple matter to remove the iron.



SIMPLE AUTOMATIC SWITCH-OPENER

ONE of the easiest made devices for throwing an electric switch automatically at a predetermined time is the alarm clock arrangement shown in the diagram below. An ordinary wooden spool is fastened to the winding key of the alarm clock. To it is fastened a stout cord, the other end of which is attached to the cross bar of the knife switch. When the alarm goes off the key winds up the cord and the switch is thrown open. The purpose of the spool is to increase the diameter of the drum on which the cord winds, thus increasing the speed of the device. An arrangement such as this is helpful to merchants and shop keepers who operate an electric sign outside their store at night which must be turned off at midnight to save current. Care must be taken to make sure that the cord does not pull directly against the switch handle, but at a slight angle. Set the clock and Father Time will finish the job!



Taking Photographs on a

THE amateur photographer who enjoys experimenting will take keen pleasure in trying his hand at taking table top photographs as here explained by Mr. Burton. All the equipment will usually be found around the house.

WHEN bleak winter days or stormy weather make outdoor photography a hardship rather than a pleasure, you need not relegate your camera to a closet shelf and suspend for a time your photographic activities. An amusing and profitable pastime for such occasions is the making of table-top photographs. As the name implies, the top of a table is the usual "studio" where the work is done. With the aid of a few toys, little statues, a desk lamp or two, and a little imagination, extremely interesting and attractive pictures can be made. They will add variety to any album, and when properly mounted and framed, will enliven the walls of any room.

By conducting a search of the house, you unearth, for example, a little clay Chinese incense burner, a carved white elephant, a fancy picture frame that looks like the entrance to a building, a few glass prisms which were purchased one time for experimental purposes, and a few other odds and ends. Perhaps you will want to enlarge your collection of subjects and "studio" accessories by a visit to a toy or novelty counter where queer-looking animals, mermaids and other aquarium figures, and a host of other suitable subjects can be found.

First you study the white elephant. Where are such beasts found? Africa and India, is it? Anyway, the little statue suggests to you mammoth, mysterious buildings and temples. That picture frame looks very much like it was made to represent the columns of a temple. So the elephant and the frame are placed on the table, with perhaps a piece of rough paper beneath them. A desk lamp, with the largest bulb available, is set at one side, and two or three glass prisms are arranged so that they cast mysterious bands of light over the elephant and surroundings. After trying different arrangements of the various objects and the light, you find one that appeals to

This illustration shows the method of making table-top photographs. The prisms and clay god which are to be photographed are placed on a sheet of paper curled up in back to catch the shadows cast by the desk lamp. Then the camera is focused, exposed for a minute, and that's all there is to it!

Table Top

by WALTER E. BURTON

you, and make the exposure. The result is a striking picture that might have been made in some far-off land where elephants and temples are not uncommon.

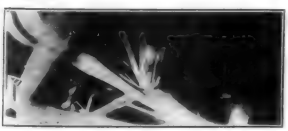
With the Chinese incense burner, the light, prisms, and a sheet of plain paper of a brownish color, you can produce another simple picture that is full of mystery. Who could fail to be interested in "The Little Clay God" when they see the picture, enlarged to 8x10 inches on buff paper with a rough surface, hanging on the wall of your room?

So many unusual lighting arrangements can be made with the aid of glass prisms that you will be repaid for purchasing two or three from a scientific house, if you expect to make many table-top photographs. Cheap prisms can be obtained for about 60 cents, and will serve just as well as the most expensive grades.

Prisms are themselves interesting because of their shapes, and because of their ability to reflect and refract light in a striking manner. "Why not photograph them?" you ask yourself. Therefore you arrange them on a table, place the light or lights in a position where numerous bands of light and shadow will be produced, and press the button. You have made a picture that will rank with the most bizarre examples of futuristic art.

Focusing the camera, making the exposure, and other technical operations will depend almost wholly upon the camera and lights you use. Of course, you must get the objects in proper focus. If the camera has no ground glass, you can refer to the instruction book and find the nearest distance from the lens that objects can be placed and yet be in focus. With the addition of a portrait attachment, still closer approach is possible. If a small image is obtained, it can be enlarged. Because artificial light of rather low intensity is being used, a long exposure will be necessary—perhaps a minute or more. But this does not matter, for the objects will not move. The best exposure must be found by experiment. Such pictures look better when not too sharp. Enlargement of the negative will introduce some softness, and more can be obtained if desired by using a pictorial diffusion disc obtainable at any store selling photographic materials.

This picture might have been taken in front of an East Indian temple—but it wasn't. A white elephant watch charm and the corner of a picture frame which happened to resemble the steps and columns of a temple were the elements which entered into its makeup.



A study in cubism, obtained by arranging several prisms in a beam of light so that the ray was shattered as it passed through them.

Table-top photography is one of the most interesting fields into which the amateur can stray. In the commercial world it is being used constantly, and you can readily see by inspecting the advertising section of almost any magazine.

Edited by **WALTER D. KERST**

Step up, you amateur movie makers, and meet Mr. Kerst, the department editor, whose photograph appears at the top of this page for the first time. Mr. Kerst is an associate member of the Society of Motion Picture Engineers and a nationally known expert on movie making technique.

Using Filters to Obtain Night Effects in Daytime

A red filter was used in making the daytime "night" exposure shown above.

FEW of the night scenes that are shown in professional or amateur movie productions are actually taken at night. Usually the scene is photographed in bright sunlight and the film tinted a deep blue in order to tone down the shadows and transform the bright patches of sunlight into shadowy moonbeams.

A red glass filter is commonly used in shooting night effects in the daytime. These pictures should be made on panchromatic film in bright sunlight, no compensation being made in exposure, for this would then merely give color correction and destroy the desired effect. Half red and half yellow filters are used where it is desired to have the sky very dark and still render the foreground detail plain enough without destroying the night effect. In this case the lower half of the picture is registered through the yellow portion of the filter and the upper half through the red.

An excellent example of a night scene taken by daylight is shown in the photograph at the left, taken in New York's Central Park. Note the detail in the upper photo, such as building windows, which is entirely missing in the filter shot. The spot of sunlight in the foreground becomes a patch of moonlight in the lower picture.

Smaller Field of View of Telephoto Lenses Requires Careful Focusing

The marked-off squares in the picture above show the fields of view embraced by four and eight inch telephoto lenses. The full size photo was taken with an ordinary one inch lens, standard on most amateur cameras.

THE ABOVE photograph of the Capitol at Washington shows the relative dimensions of pictures obtained when using lenses of different focal lengths. Assuming that the entire picture as illustrated was made with the usual one-inch lens, the next smaller enclosing frame marks the boundary lines of the picture obtained with a four-inch telephoto lens, and the smallest rectangle shows the picture obtained with an eight-inch lens.

For example, an amateur shooting this scene wishes to get close-ups of the figure on the top of the dome. The illustration shows the field of view included by the eight-inch lens and this would be a large close-up of the figure when projected on the screen. Because of the great amount of atmosphere between the telephoto lens and the object being photographed, unless a filter is used the object is likely to be dim and obscure and the details lost. The filter removes or cuts through the haze, allowing the object to be registered on the film with the same clarity as if a person were actually seeing the statue from a point eight times closer than the viewpoint from which the picture was made when using the one-inch lens, which, because of its shorter focal length, narrower angle, and smaller power of magnification, included much more in the picture.

Telephoto lenses should be fitted by the manufacturer or some reliable motion picture mechanic to the cameras on which they are to be used. If the lens is not set correctly for distances 50 feet or beyond, then all the careful focusing on objects that distance and nearer is of no avail. Telephoto lenses are also usually supplied with matched viewfinders. That is, the four-inch lens is used with a finder that will show the cameraman exactly what is included in the field of view by that particular lens. Care should be taken to see that these finders coincide exactly with the field of view included by the lens on the film. Telephoto lenses that are available for 16 mm. cameras and that are carried in stock by photographic dealers are the three-inch, three and three-quarter inch, four and six-inch lenses. Each gives a magnification over the one-inch lens the number of times indicated by its focal length, viz: a three-inch lens gives an image three times the size of a one-inch lens; a six-inch lens, six times, etc. Lenses of greater focal length can be fitted to 16 mm. cameras on special order.

FOR THE amateur movie maker who would like to own a few hundred feet of film on a weird subject with which to liven up his home entertainments and perhaps startle some of his spectators, the following method of photographing a skeleton dance is recommended. Secure a quantity of strontium thiosulphate and mix it in varnish, shellac, or some similar transparent vehicle. Expose the mixture to the sun's rays for a few hours. When the substance is painted on white cloth, as shown in the photograph, and all lights turned off, the painted portions will be found to glow weirdly with their own illumination. A bit of experimenting with the movie camera is usually necessary before the correct adjustments as to focus and exposure are obtained, but the finished results usually justify the efforts expended in obtaining them.

WINTER PRECAUTIONS

CERTAIN precautions should be taken in using the movie camera in the winter time. The problem of exposure is one to which strict attention should be paid. A side or back lighting will give good contrast in snow scenes and the exposure should be ample so that the details in the shadows will register on the film. A filter is invaluable in this type of work for it holds back the blue rays, which the snow strongly reflects from the sky, and allows the snow to register on the film so that it will not be a stark white on the screen. In making close-ups outdoors with snow on the ground, the snow is a natural reflector and throws the light of the sun up into the face. When shooting pictures in a snowstorm the camera should be protected by an umbrella so that the flakes will not fall too near the lens and obscure the picture, for, being out of focus, they will be blurry. The umbrella also keeps the flakes from falling on the lens which means total loss of the scene being filmed.

Don't let the film track in the camera and projector become clogged with emulsion and dirt. Clean the track in the camera after every 100 feet of film. It is sufficient to clean the projector film track after every 1,000 feet of film has been run.

BLUE GLASS FILTER

EVERY amateur cameraman should provide himself with a blue glass viewing filter, sometimes called a "monotone" filter. Such a filter is used by all professional cameramen. As is well known, colors do not register their true value on the film in black and white. For example, yellow photographs a dark gray; blue, a very light gray or white; red photographs black, etc. When a scene to be filmed is viewed through the monotone filter held close to the eye, it shows the cameraman exactly how the scene looks in black and white. Many a shot, beautiful for its color, and disappointing in black and white, would not be taken and film would be saved if it were viewed through this filter. These filters are procurable from most all dealers in amateur movie equipment.

LENS TURRET

THE 16 mm. Victor Cine camera can now be obtained equipped with a turret holding three lenses. This is the first 16 mm. camera to be equipped in this manner and marks another forward step in the design of 16 mm. equipment for the amateur. The turret is easily revolved and a lens of different focal length or speed can be snapped into place over the aperture in an instant.

The next time you are seeking an unusual shot for your movie camera, try this spider-web scene as worked out by Director William K. Howard, shown above with Janet Gaynor in a scene from the Fox star's newest photoplay, "Christina." A few bits of thin white thread suspended in front of the camera lens gives the spider-web illusion in the completed play.

How to Make "Close-Ups" With Ordinary Fixed Focus Lenses

TOO MANY amateurs do not appreciate the value of the close-up shot in making their films interesting. This is in a great measure probably due to the fact that many of them have universal or "fixed focus" lenses on their cameras and bringing the subject too close to the lens results in blurry, out of focus pictures. For this group possessing such lenses the following chart showing the number of turns the lens must be unscrewed from its mount indicates how sharp close-ups can be made at varying distances with the fixed focus lens. The table refers to the Filmo camera and should be helpful also for making titles with the fixed focus lens.

Distance of Object	Number of Turns
7′ 6″	One-quarter turn.
6′ 1″	Three-eighths turn.
1′ 8″	One-half turn.
3′ 8″	Three quarter turn.
2′ 9″	One turn.
1′ 9″	One and one-half turn.

Divide the circular mount on the camera into which the lens screws into eight parts. White ink can be used for this purpose. Place a white mark on the lens itself at the point from which you start to turn. This will enable you to quickly and accurately set the lens for any desired distance.

Those who have lenses in focusing mounts can, of course, focus to as near as two feet in most instances. In shooting pictures a good general rule to follow is to use a long shot for the opening of a scene, then a medium shot, which is near enough so that the action may be understood, and then to a close-up of the detailed action. A large percentage of every reel you show should consist of close-ups. The small amateur screen size makes it difficult to distinguish detail and action in a distant shot and such shots should be held down to a minimum, both as to number and length.

DON'T

—load your camera in bright sunlight or your film will be fogged.
—breathe while shooting with the camera held in the hand. Take a deep breath and hold it while you press the button. Your pictures will be much steadier on the screen.
—clean your lens with water, alcohol, or any liquid. Breathing on it and wiping it with a well-laundered handkerchief is all that is necessary.
—shoot close-ups at two feet with a fixed focus lens. Your close-ups will be blurry.
—take telephoto shots on a dull or misty day. Choose a time, preferably after a rain, when the atmosphere is crystal clear.

Berlin Hand-Organ Exchange Does Big Business

HAND organs of all descriptions, together with accessories of the trade such as monkeys, are rented to hurdy-gurdy men by the day or week by a Berlin hand-organ exchange which does a flourishing business. The photo shows a few of the "grind-organ" men checking out at the beginning of the day's work.

Although the monkeys are rented only for a day or so at a time, depending upon the financial resources of the hurdy-gurdy renters, the animals frequently exhibit a surprising affection for their temporary owners, even assisting in such homely tasks as bathing the head, as shown in the picture in the circle. Without a monkey the hand-organ man stands a poor chance of making a profit on the day's work.

MODEL SPEED BOAT DEVELOPS 45 M. P. H.

MODEL boat enthusiasts who visited the model speed boat display at the recent Model Engineering Exhibition in London were fascinated by a remarkable steam driven model which developed the amazing speed of 45 miles an hour under its own steam. The tiny speed craft, shown in the photo, is driven by a two-cylinder steam engine, the boiler of which is located in the rear of the hull where it is fired with a gasoline torch.

The ordinary model boat will run as long as its operator stands beside it, but fails to function when placed under its own power. The designer of this model, however, planned the details of its construction so thoroughly and designed its propelling mechanism so simply and efficiently that the craft not only runs but attains the astonishing speed of three quarters of a mile a minute. Boat designing is one of the most popular branches of the model maker's art, and articles on this subject will appear frequently in the pages of MODERN MECHANICS.

This Giant Tube Broadcasts Voice of Movie Star

RADIO has taken an important part in the affairs of movie artists as is demonstrated by the fact that the largest and the smallest radio tubes ever made were used recently in reproducing the voice of Anita Page. The large tube was used to project her voice in a radio broadcast, while the small one played an intricate part in adjusting her recording voice in a movietone production.

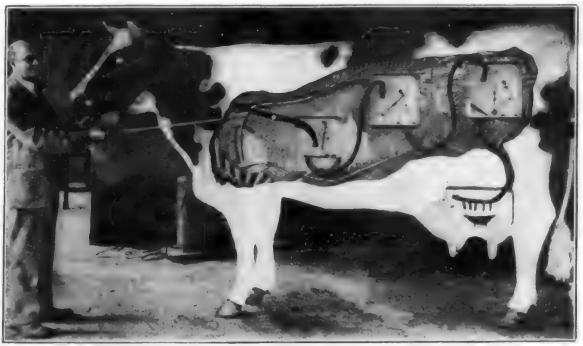
If one happens to see Miss Page in the Metro-Goldwyn-Mayer picture "The Broadway Melody," one can realize the part that radio is taking in the moving picture field. Sound pictures that are delighting American movie goers today are dependent upon the radio expert for the results that are obtained. The tubes here shown take part both in the recording and the rebroadcasting of the picture.

Anita Page poses with the two radio tubes that are used in recording her voice for a movietone picture.

TALKING COW ADVISES FARMERS

UNCLE SAM'S talking cow, shown below, has just been manufactured by the Department of Agriculture at Washington. This cow talks with a loud and commanding voice which gives an interesting lecture about the various new methods that the Department has devised for the betterment of the dairy industry.

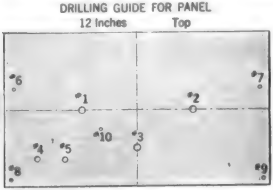
In order that listeners may gain further information from the cow the builders partly dissected her body so that the various processes of transforming food into milk may be explained by the operator. The dissected portion also serves to attract attention so that people will stop and listen to the cow's "oration."



By CHARLES MAGEE ADAMS

Complete plans for making a one tube radio set which is an excellent receiver both for distance and volume are here presented by Mr. Adams, Modern Mechanics' Radio Editor.

IN THE first issue of MODERN MECHANICS was a brief article describing a simple one-tube receiver. So many letters have showered in on the radio editor asking for details regarding its construction that he has prepared this second article giving complete instructions for building and operating the set. Anyone can make it with little trouble and at small expense.

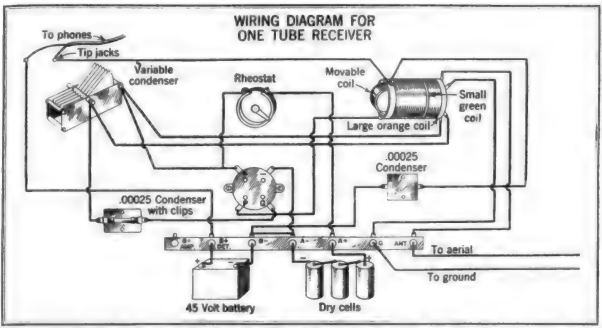


Dimensions for boring the dial panel are given here.

The first step is, of course, obtaining the necessary parts. These are as follows:

One baseboard 8 by 12 by $\frac{5}{8}$ inches.
One hard rubber panel 7 by 12 by $\frac{3}{16}$ inches.
One DeJur universal 3-circuit coupler.
One DeJur straight line variable condenser. .0005 mfd.
One DeJur molded fixed condenser, .00025 mfd.
One DeJur molded fixed condenser, .00025 mfd., with clips.
One Eby four-prong socket.
One Eby binding post strip.
Two Eby tip jacks.
One Kelford rheostat. 30 ohms.
Two 3-inch dials.
One 4-megohm grid leak.
Two 4-inch angle braces.
One roll Braidite hook up wire.

The baseboard can probably be picked up from the scrap pile in the workshop.



Schematic diagram showing hookup for Mr. Adams' one tube set. Good distance can be had with this set.

Next, the panel is drilled. As can be seen from the diagram, two sizes of drills will be required for this work—one $\frac{3}{8}$, the other $\frac{3}{16}$.

Now insert the two tip jacks in the three-eighths inch holes $1\frac{1}{4}$ inches apart, tightening the locknuts securely. Then remove the rotating arm of the rheostat by loosening the set screw which holds it to the shaft. Remove the shaft and knob and mount the body of the rheostat in the $\frac{3}{16}$-inch hole in the lower center of the panel. Be sure the two binding posts are turned up. Insert the knob and shaft, and replace the rotating arm.

The two 4-inch angle braces should now be screwed to the baseboard and the panel fastened to them and the front edge of the baseboard, using a pair of $\frac{3}{4}$ by $\frac{6}{32}$ machine screws with nuts for the upper holes and $\frac{3}{4}$-inch No. 8 round head wood screws for the lower.

Fasten the binding post strip at the rear of the baseboard with the soldering lugs toward the panel. Screw down the socket in the center of the baseboard with the filament terminals facing the rheostat, and mount the two fixed condensers at either side of it.

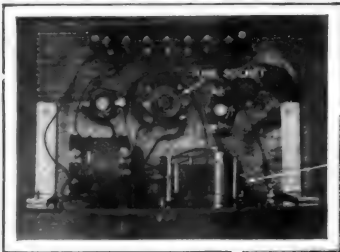
The wiring can now begin. Note that the hook up wire need not be scraped. The insulation can be slipped back from the end, then pushed up snug against the joint after the connection has been made.

Connect the —A post on the strips of the —F on the socket; the +F on the socket to one terminal of the rheostat, and the other terminal of the rheostat to the +A post on the strip.

Now mount the variable condenser on the panel, fastening it securely with the locknut and machine screw. Connect the G terminal of the socket to one terminal of the fixed condenser with the clips attached: the other terminal of this fixed condenser to the end terminal of the variable condenser, leaving enough wire to reach across to the 3-circuit coupler. Next, connect the F+ terminal of the socket to the upper side terminal of the variable condenser, again leaving enough wire to reach to the 3-circuit coupler.

Then, with the coupler still unmounted, connect these two wires from the variable condenser to the two terminals at one end of the coupler to which the large coil of orange

Front view of the simple one tube set.



To the left is a top view of the one tube radio set which proved so popular in the Nov. issue of Modern Mechanics. Note its simplicity.

To the right is a three-quarters rear view of the one tube set designed by the Radio Editor. This simple, cheap set is shown without tube installed.

wire is connected.

Now connect the B+ detector post on the strip to one of the tip jacks; and the other tip jack to one of the terminals on the coupler to which the small movable coil is connected, leaving a few inches to spare. Then mount the coupler on the panel by means of the locknut, turning the long axis parallel with the baseboard. The end of the last wire connected should now be connected to one terminal of the fixed condenser which has no clips, and the other terminal of this condenser to the B— post on the strip. Connect the B— post to the —A post. The B+ amp. post on the strip is not used.

Next, connect the remaining terminal of the movable coil on the coupler to the P terminal of the socket. Finally, connect the two terminals of the coupler which connect to the small green coil to ant. and gnd. posts on the strip.

Mount the dials on the protruding ends of the condenser and coupler shafts. The condenser dial should be set to indicate 0 when the movable plates are entirely closed.

To put the receiver in operation there will be needed a tube, A and B batteries, and a pair of headphones, besides an aerial and ground connections. The tube recommended is one of the 199 type. The A battery for it consists of three standard dry cells connected in series, as shown in the diagram 1, while the B battery is a 45-volt. Connect the B battery to the B+ det. and B— posts, and the A battery to the A+ and A— posts, being careful to connect the + posts of the battery to the + posts of the strip and the — of the battery to the — of the strip; in both cases.

Connect the aerial and ground to their respective posts. Plug the tips of the phone cords into the tip jacks, insert the tube in the socket, and slip the grid leak into the clips on the fixed condenser.

The tube should now be lighted by turning up the rheostat to about three-fourths full. Then, with the condenser or right-hand dial turned to 0, turn the coupler or left-hand dial slowly to the right. At a certain point a "plop" will be heard, repeated as the dial is turned back. This indicates that the receiver is in oscillation. With the coupler dial at the point which gives this "plop," rotate the condenser dial slowly up the scale. If a station is on the air within range, a whistle will be heard. To bring it in, turn back the coupler dial slowly, adjusting the condenser dial meanwhile. A setting for both dials will be found at which the station comes in clearly.

The receiver, as described, can be constructed in a few hours and if the directions are carefully followed it will give excellent results for a one-tube set, besides supplying the beginner with the practical experience indispensable for undertaking the building of a more elaborate receiver.

Edited by **CHARLES MAGEE ADAMS**

Charles Magee Adams was one of the early pioneers in the field of radio, and he has followed developments in the industry so closely that he has won an enviable national reputation as an expert in his field. This month he has sent us his latest photograph, which is included in the department head at the top of this page.

Simple Television Kit Makes Set Building Easy

AS further evidence that television is evolving gradually from the plaything of skilled laboratory specialists to something within the capabilities of the average experimenter, a New Jersey manufacturer has brought out a television receiver available either in assembled form ready to operate or in kit form requiring a few hours work to put it into service. This receiver, designed for connection to the detector of either a standard broadcast or short-wave set, incorporates some interesting features.

One of the important problems in television which has heretofore received little attention is the faithful audio amplification of the signal. For televising a 48-line picture amplifiers must amplify quite well all frequencies from 16 to 20,000 cycles per second, while for audible reception an amplifier giving a uniform response from 32 to 5,000 or 6,000 cycles is adequate. From this it can be seen that amplifiers of a type usually employed in broadcast receivers are not satisfactory for television. Accordingly the new receiver incorporates a special resistance-coupled audio amplifier, consisting of two stages of voltage amplification with a third stage of two power tubes connected in parallel to supply the necessary current for the neon lamp.

Either '71 or '10 type power tubes may be used. The former supply sufficient current for a neon lamp with plates one inch square, giving ample illumination for a 24-line picture. The '10 type tubes are required for neon lamps with plates 1½ inches square, necessary for 48-line pictures.

Another important problem of television has been the choice of the proper scanning disc for use with the particular signal being received. Though efforts looking to standardization are being made, three dif-

The simple, compact nature of the commercial television receiving set is well shown by the above photo. All the elements of the set are included in one small package.

With the scanning disc, neon lamp and motor all assembled in the cabinet, the television receiver will be ready for service when hooked up. Contrary to the general belief, elaborate and complicated apparatus is not required to receive pictures via wireless.

ferent types of signal are being broadcast—24, 36, and 48-line. Where the experimenter is located within range of only one station a single scanning disc adapted to its signal is sufficient, but if two or three stations are within range and these use a different number of lines it will be necessary to change discs in order to shift from one to the other. To eliminate this inconvenience the new receiver employs a combination scanning disc designed for 24, 36, or 48-line reception, and requiring only an adjustment of the neon lamp to change from one to the other. It can also be secured with any of the three standard discs.

The motor included in the receiver, of the induction type, is free from commutator spark, preventing a spotty picture. Speed control is accomplished by means of a manually operated rheostat.

In assembling the kit the various parts may be mounted in the open, though an enclosing cabinet is suggested to exclude extraneous light.

KEEP AERIAL WIRE TAUT

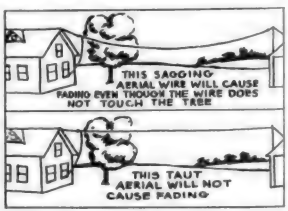
WHEN erecting an outdoor aerial, it is important that the overhead wire, as well as the lead-in, be placed under sufficient tension to keep both taut at all times.

The purpose of this is not, as is often supposed, merely to prevent the wire from coming in contact with buildings or trees due to sagging or swaying in the wind. Such contact is, of course, always to be avoided because it will ground the aerial, causing loss of signal. A taut wire is equally important, however, to prevent fading.

Many fans do not realize that a slack receiving aerial can cause fading. But it can. The explanation is that an aerial swaying in the wind, by causing a variation in the distance between itself and the ground, alters the electrical capacity between the overhead system and the earth, causing, in turn, the receiver to be detuned. It will be found that much fading charged to transmitters or atmospheric conditions is due to this swaying of receiving aerials.

It is, of course, not practicable to draw 60 or 80 feet of small wire quite straight. Under such a strain the strands will part. But the sag should be kept as small as possible. Also the lead-in, particularly if it is long, should be free from excessive sway.

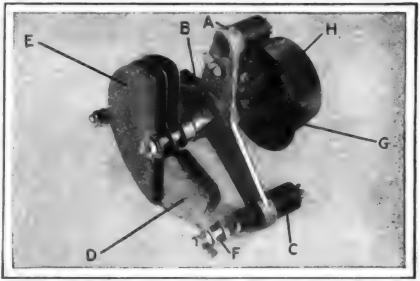
If the aerial is being erected on a warm day no allowance need be made for contraction due to cold. There will usually be ample stretch to take care of this. In fact, the stretch will often have to be taken up after the aerial has been in service a few weeks.



It is easier to permit an aerial to sway slackly than to keep it properly taut, but the owner usually pays for his carelessness in the unsatisfactory performance of his set. The aerial in the lower picture is properly tensioned.

Mercury Bearing Insures Perfect Contact in Short Wave Condenser

TO meet the need for an efficient condenser designed expressly for short-wave work a New York radio engineering laboratory has developed a new variable condenser, known as the REL, with several interesting features. The model illustrated, having a maximum capacity of 54 mmfd., consists of three rotor and two stator plates and is typical of the construction employed.



This new type short-wave condenser employs several novel features of construction. Notable among these is the patented method of immersing the rotor shaft in mercury, insuring positive contact at all times.

The die-cast aluminum end member "A" affords a wide three-corner mounting to panel and, due to its ruggedness and also to the thickness of the metal employed in the plates, there is no possibility of difficulties with vibration. It will be noted too that there are insulated panel stand-off bushings "C" which allow mounting to a metal panel without necessarily grounding stator or rotor.

A uniquely designed one-piece bearing "B" supports the steel cadmium-plated shaft "H." This is a double conical bearing with a specially designed spring adjusting tension device "G" which may be set as desired.

Because mechanical friction noises are introduced by non-positive rotor contacts if condensers are employed in circuits operating at 10,000 k. c. or higher, the designers have devised and patented an arrangement whereby the rotor shaft is immersed in mercury, held inside the bearing "B." There is no doubt regarding the positiveness of this contact.

The plates are of heavy brass, the stator specially shaped so there will be no disturbing capacity increase when the rotor passes the point at which the stator plates are bound together.

SAFETY FIRSTS FOR B-UNITS

THOSE radio fans who have been accustomed to battery operated receivers need to exercise definite precautions when dealing with sets powered by modern B units.

Because the 90 to 135 volts delivered by batteries produces only a tingling shock, many regard lightly the risk of contact with live 110-volt circuits. The real danger, however, lies in contact with the 180 to 500 volts now supplied to the last audio stage. This potential produces a real shock, which can be serious due to the large amperage.

The first safety rule, accordingly, is to make adjustments on live parts of a receiver only when the current is turned off. In the few cases where it is necessary to make adjustments with the set live, insulated tools should be used. Rubber tubing or friction tape over the handles of pliers or screwdrivers will afford reasonable protection.

Second, even when such precautions against shock are observed, short-circuits must also be avoided. It must be remembered that metal parts of receivers, such as shields, transformer and condenser cases, and panels, are usually grounded. Should a tool, even when insulated from the user, make contact between this grounded metal and a live B circuit, the result will be a short whose consequences may be burned-out equipment.

This suggests a third safety measure, which is to insert a 2 or 3 ampere fuse in the 110-volt supply circuit. This will usually but not always prevent damage in case of accidental short-circuit.

Get into this Coo-Coo Contest

Winners in Coo-Coo Contraptions Contest No. 2 and rules for Contest No. 5 are printed below.

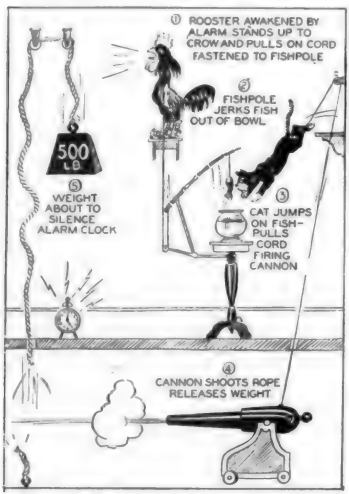
SEVEN lucky contestants in Coo-Coo Contraptions Contest No. 2 are busy figuring out what to do with the $50 prize money which the contest editor has just finished distributing among them. If you have use for a bit of spare change, sharpen your pencil and get in on Contest No. 5, which closes April 1, 1929.

All that is necessary is to concoct a Coo-Coo Contraption as funny as or funnier than the "Agent Eliminator" and the "Alarm Clock Silencer" shown on this page, and send your design to the Coo-Coo Contest Editor, Contest No. 5, Robbinsdale, Minn.

The inventor of the agent eliminator is M. Ross Savauge of Seaforth, Ontario, Canada, who won the first prize of $25 in Contest No. 2. His device may seem a little elaborate at first glance, but it's guaranteed to get results, and once an agent has been eliminated he usually hesitates about paying a second visit—the mule attends to that!

No less ingenious is the alarm clock silencer invented by Donald Gregg, 318 S. Albany Street, Ithaca, New York, for which he received second prize of $10. As a means of turning off the alarm when the clock has awakened you in the morning, it's hard to beat. Of course, the 500 pound weight flattens out the clock so that it is of no further service, but the clock can easily be replaced with a new one.

The five third prizes of $3 each went to contestants scattered in all parts of the country, as follows: E. L. Deeter, 5899 Clemens Ave., St. Louis, Mo.; Sam Cantrell, Box 321, Panhandle, Texas; Frank Palmisano, 2034 Reading Road, Cincinnati, Ohio; W. H. Buntin, 1437 Polk St., San Francisco, Cal.; and Francis Hewens, 113 East Fourth St., Brooklyn, N. Y.



In Contest No. 5, announced herewith, $50 in prizes will be given, distributed as follows: First prize, $25; Second prize, $10; Five third prizes, $3 each. Closing date of this contest will be April 1, 1929. Manuscripts received later than this date will automatically be entered in Contest No. 6. No manuscripts will be returned; if you wish to preserve your Coo-Coo Contraption, be sure to retain a copy. Everybody is eligible to compete except employees of Fawcett Publications, Inc., or their families. In case of a tie for any of the prizes, duplicate awards will be made to each of the tying contestants. It is not necessary to be a subscriber to Modern Mechanics to compete.

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On Sale March First

LOST INSIDE THE EARTH

(Continued from page 123)

sustained and frightful ferocity transcends the power of imagination or description. Time and again the colossal bull tossed the enormous tiger high into the air, but each time that the huge cat touched the ground he returned to the encounter with apparently undiminished strength, and seemingly increased ire.

For a while the man and woman busied themselves only with keeping out of the way of the two creatures, but finally I saw them separate and each creep stealthily toward one of the combatants. The tiger was now upon the bull's broad back, clinging to the huge neck with powerful fangs while its long, strong talons ripped the heavy hide into shreds and ribbons.

All its efforts to rid itself of the tiger seemed futile, until in desperation it threw itself upon the ground, rolling over and over.

The great cat clawed at the shaggy head until eyes and ears were gone, and naught but a few strips of ragged, bloody flesh remained upon the skull. Yet through all the agony of that fearful punishment the thag still stood motionless pinning down his adversary, and then the man leaped in, seeing that the blind bull would be the least formidable enemy, and ran his spear through the tarag's heart.

As the animal's fierce clawing ceased, the bull raised his gory, sightless head, and with a horrid roar ran headlong across the arena.

Swinging his bloody horns from side to side the beast cut a wide swath before him straight upward toward our seats. Before him slaves and gorilla-men fought in mad stampede to escape the menace of the creature's death agonies, for such only could that frightful charge have been.

Forgetful of us, our guards joined in the general rush for the exits, many of which pierced the wall of the amphitheater behind us. Perry, Ghak, and I became separated in the chaos which reigned for a few moments after the beast cleared the wall of the arena, each intent upon saving his own hide.

I ran to the right, passing several exits choked with the fear-mad mob that were battling to escape.

Once out of the direct path of the animal, fear of it left me, but another emotion as

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Winner Gets CASH and HUDSON BOTH! 15 Other Cash Prizes

Someone who has a sharp eye for solving puzzles is going to win this Big Cash Prize of $1,000 and in addition a Brand New Hudson Coach for promptness, if on time—or $2,400 in all. Will it be You?

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To quickly advertise the name and products of the Paris-American Pharmacal Co., and make them better known, we are dividing our profits and absolutely giving away 16 BIG CASH PRIZES, ranging from $1,000.00 down and a NEW HUDSON COACH for promptness—if the first prize winner is on time. What's still more—we will reward hundreds of others with $1.25 worth of our products and duplicate prizes will be given on all awards in case of final ties. It costs you nothing to solve this puzzle—you do not have to subscribe to any magazine or secure any subscriptions to win any of the 16 BIG CASH PRIZES, ranging from $1,000.00 down or the Hudson Coach for promptness with the $1,000.00 cash first prize. Neither is it necessary to sell anything.

Solve this puzzle and solve it quick. There's too much at stake for you to delay a minute. Take a pencil and draw a line showing how the auto can be driven out of the field pictured above. There's all kinds of fences in your way and there's only one gate out of the field, but if your eyes are sharp you MAY find a way thru the various gates in the fences, and get your auto out.

If you find the way out, cut out the puzzle and SEND YOUR ANSWER QUICK

Some sharp-eyed person is going to win the $1,000 CASH and the auto, too, if on time. Why not you? The Hudson is a prize for PROMPTNESS. If you win the $1,000 you want to get the Hudson, too. Send your answer, TODAY. We will let you know at once, how close you are to winning, how to get the $1,000 first prize, and make the Hudson yours. There will be no delay in giving you your award for solving the puzzle, so mail your answer AT ONCE.

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LOST INSIDE THE EARTH

quickly gripped me—hope of escape that the demoralized condition of the guards made possible for the instant. As it was I hastened on toward the right searching for an exit toward which no Sagoths were fleeing, and at last I found it—a low, narrow aperture leading into a dark corridor.

Without thought of the possible consequences, I darted into the shadows of the tunnel, feeling my way along through the gloom for some distance.

Presently the light increased and a moment later, to my delight, I came upon a flight of steps leading upward, at the top of which the brilliant light of the noonday sun shone through an opening in the ground.

Cautiously I crept up the stairway to the tunnel's end, and peering out saw the broad plain of Phutra before me. The numerous lofty, granite towers which mark the several entrances to the subterranean city were all in front of me—behind, the plain stretched level and unbroken to the near-by foothills. I had come to the surface, then, beyond the city, and my chances for escape seemed much enhanced.

My first impulse was to await darkness before attempting to cross the plain, so deeply implanted are habits of thought; but of a sudden I recollected the perpetual noonday brilliance which envelops Pellucidar, and with a smile I stepped forth into the daylight.

I have no idea, of course, how long it took me to reach the limit of the plain, but at last I entered the foothills, following a pretty little canyon upward toward the mountains. Beyond was a steep declivity to the shore of a placid, inland sea, upon the quiet surface of which lay several beautiful islands.

The view was charming in the extreme, and as no man or beast was to be seen that might threaten my new-found liberty, I slid over the edge of the bluff, and half sliding, half falling, dropped into the delightful valley, the very aspect of which seemed to offer a haven of peace and security.

As I walked, my eyes were bent upon the beach so that it was not until I had come quite upon it that I discovered that which shattered all my beautiful dream of solitude and safety and peace and primal overlordship. The thing was a hollowed log drawn up upon the sands, and in the bottom of it lay a crude paddle.

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LOST INSIDE THE EARTH

The rude shock of awakening to what doubtless might prove some new form of danger was still upon me when I heard a rattling of loose stones from the direction of the bluff, and turning my eyes in that direction I beheld the author of the disturbance, a great copper-colored man, running rapidly toward me.

The speed of the fellow seemed to preclude the possibility of escaping him upon the open beach. There was but a single alternative—the rude skiff—and with a celerity which equaled his, I pushed the thing into the sea and as it floated gave a final shove and clambered in over the end.

A cry of rage rose from the owner of the primitive craft, and an instant later his heavy, stone-tipped spear grazed my shoulder and buried itself in the bow of the boat beyond. Then I grasped the paddle, and with feverish haste urged the awkward, wobbly thing out upon the surface of the sea.

A glance over my shoulder showed me that the copper-colored one had plunged in after me and was swimming rapidly in pursuit. His mighty strokes bade fair to close up the distance between us in short order, for at best I could make but slow progress with my unfamiliar craft.

I had covered some hundred yards from shore when it became evident that my pursuer must grasp the stern of the skiff within the next half-dozen strokes. In a frenzy of despair, I bent to that grandfather of all paddles in a hopeless effort to escape, and still the copper giant behind me gained and gained.

His hand was reaching upward for the stern when I saw a sleek, sinuous body shoot from the depths below. The man saw it too, and the look of terror that overspread his face assured me that I need have no further concern as to him, for the fear of certain death was in his look.

And then about him coiled the great, slimy folds of a hideous monster of that prehistoric deep—a mighty serpent of the sea, with fanged jaws, and darting forked tongue, with bulging eyes, and bony protuberances upon head and snout that formed short, stout horns.

Unconsciously I had ceased paddling as the serpent rose to engage my pursuer, so now the skiff still drifted close beside the two. The monster seemed to be but playing with his victim before he closed his

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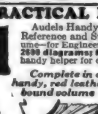

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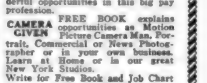

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LOST INSIDE THE EARTH

awful jaws upon him and dragged him down to his dark den beneath the surface to devour him.

At last I could endure no longer to sit supinely by while a fellowman was dragged down to a horrible death by that repulsive reptile. Embedded in the prow of the skiff lay the spear that had been cast after me by him whom I suddenly desired to save. With a wrench I tore it loose, and standing upright in the wobbly log drove it with all the strength of my two arms straight into the gaping jaws of the hydrophidian.

With a loud hiss the creature abandoned its prey to turn upon me, but the spear, imbedded in its throat, prevented it from seizing me though it came near to overturning the skiff in its mad efforts to reach me.

The aborigine, apparently uninjured, climbed quickly into the skiff, and seizing the spear with me helped to hold off the infuriated creature. Blood from the wounded reptile was now crimsoning the waters about us and soon from the weakening struggles it became evident that I had inflicted a death wound upon it. Presently its efforts to reach us ceased entirely, and with a few convulsive movements it turned upon its back quite dead.

And then there came to me a sudden realization of the predicament in which I had placed myself. I was entirely within the power of the savage man whose skiff I had stolen.

Presently he spoke to me, but in a tongue which I was unable to translate. I shook my head in an effort to indicate my ignorance of his language, at the same time addressing him in the bastard tongue that the Sagoths use to converse with the human slaves of the Mahars.

To my delight he understood and answered me in the same jargon.

"Who are you," he said, "and from what country do you come?"

I too sat down, laying the spear between us, and tried to explain how I came to Pellucidar, and where from, but it was as impossible for him to grasp or believe the strange tale I told him as I fear it is for you upon the outer crust to believe in the existence of the inner world.

So I gave it up and asked him about himself. He said he was a Mezop, and that his name was Ja.

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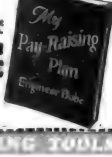

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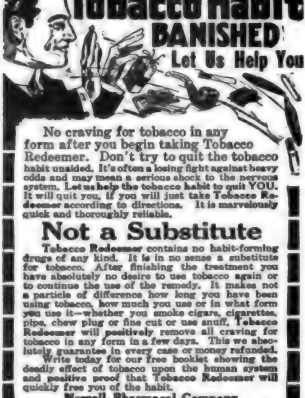

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LOST INSIDE THE EARTH

"Who are the Mezops?" I asked. "Where do they live?"

He looked at me in surprise.

"I might indeed believe that you were from another world," he said, "for who of Pellucidar could be so ignorant! The Mezops live upon the islands of the seas.

"We are fishermen, though we be great hunters as well, often going to the mainland in search of the game that is scarce upon all but the larger islands. And we are warriors also," he added proudly. "Even the Sagoths of the Mahars fear us.

"The great ones even come to our islands. It is there, far from the prying eyes of their own Sagoths, that they practice their religious rites in the temples they have builded there with our assistance."

During our conversation Ja had taken the paddle and was propelling the skiff with vigorous strokes toward a large island that lay some half-mile from the mainland. As we touched the pretty, level beach Ja leaped out and I followed him. Together we dragged the skiff far up into the bushes that grew beyond the sand.

We ate and slept, and when I awoke I found that Ja had left me, but I was not alarmed, since he had told me that he expected to go out and slay an animal to supply us with food.

Curiosity prompted me to walk down to the beach, for the scene was very beautiful. As I passed along beside the deep and tangled vegetation of the swamp I thought that I saw a movement of the ferns at my left, but though I stopped a moment to look it was not repeated, and if anything lay hid there my eyes could not penetrate the dense foliage to discern it.

I was dreaming of the excitement and adventure which lay before us could Perry and I but escape the Mahars, when something, a slight noise I imagine, drew my attention behind me.

As I turned, romance, adventure, and discovery in the abstract took wing before the terrible embodiment of all three in concrete form that I beheld advancing upon me.

A huge, slimy amphibian it was, with toad-like body and the mighty jaws of an alligator. Its immense carcass must have weighed tons, and yet it moved swiftly and silently toward me.

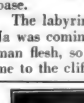
To seek escape in the swamp or in the ocean would have been similar to jumping

LOST INSIDE THE EARTH

into a den of lions to escape one upon the outside.

The labyrinthodon was coming more slowly now. He seemed to realize that escape for me was impossible. He was about fifty feet from me when I heard a voice calling to me from the direction of the bluff at my left. I looked and could have shouted in delight at the sight that met my eyes. for there stood Ja, waving frantically to me, and urging me to run for it to the cliff's base.

The labyrinthodon evidently thought that Ja was coming to double his portion of human flesh, so he was in no haste to pursue me to the cliff and frighten away this other



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titbit. Instead he merely trotted along behind me.

As I approached the foot of the cliff I saw what Ja intended doing. He had come down to within twenty feet of the bottom, and there, clinging with one hand to a small ledge, and with his feet resting precariously upon tiny bushes that grew from the solid face of the rock, he lowered the point of his long spear until it hung some six feet above the ground.

To clamber up that slim shaft without dragging Ja down and precipitating both to the same doom from which the copper-colored one was attempting to save me seemed utterly impossible, and as I came near the spear I told Ja so, and that I could not risk him to try to save myself.

But he insisted that he knew what he was doing and was in no danger himself.

So I grasped the spear and clambered up toward the red man as rapidly as I could—being so far removed from my simian ancestors as I am. I imagine the slow-witted sithic, as Ja called him, suddenly realized our intentions and that he was quite likely to lose all his meal instead of having it doubled as he had hoped.

I made a frantic effort to reach Ja's hand, the sithic gave a tremendous tug that came near to jerking Ja from his frail hold on the surface of the rock, the spear slipped from his fingers, and still clinging to it I plunged feet foremost toward my executioner.

At the instant that he felt the spear come away from Ja's hand the creature must have opened his huge jaws to catch me, for when I came down, still clinging to the butt end of the weapon, the point yet rested in his mouth and the result was that the sharpened end transfixed his lower jaw.

With the pain he snapped his mouth shut. I fell upon his snout, lost my hold upon the spear, rolled the length of his face and head, across his short neck onto his broad back and from there to the ground.

Scarce had I touched the earth than I was upon my feet, dashing madly for the path by which I had entered this horrible valley. A glance over my shoulder showed me the sithic engaged in pawing at the spear stuck through his lower jaw, and so busily engaged did he remain in this occupation that I had gained the safety of the cliff top before he was ready to take up the pursuit.

I hastened to the cliff edge above Ja and

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LOST INSIDE THE EARTH

helped him to a secure footing. He would not listen to any thanks for his attempt to save me, which had come so near miscarrying.

"You shall become a member of my tribe," he said. "Among us there is the best of hunting and fishing, and you shall have, to choose a mate from, the most beautiful girls of Pellucidar. Will you come?"

I told him about Perry then, and Dian the Beautiful, and how my duty was to them first. Afterward I should return and visit him—if I could ever find his island.

"You would return to captivity?" cried Ja.

"My friends are there," I replied, "the only friends I have in Pellucidar, except yourself. What else may I do under the circumstances?"

He thought for a moment in silence. Then he shook his head sorrowfully.

"It is what a brave man and a good friend should do," he said; "yet it seems most foolish, for the Mahars will most certainly condemn you to death for running away."

"I see no other way, Ja," I said, "though I can assure you that I would rather go to Sheol after Perry than to Phutra."

As we talked we had been walking up the canyon down which I had come to the great ocean and the sithic. Ja did his best to dissuade me from returning to Phutra, but when he saw that I was determined to do so, he consented to guide me to a point from which I could see the plain where lay the city. To my surprise the distance was short.

I was sorry to part with Ja, for I had come to like him very much indeed.

Down the hillside I made my way into the gorgeous field of flowers, then across the rolling land toward the shadowless columns that guard the ways to buried Phutra. At a quarter-mile from the nearest entrance I was discovered by the Sagoth guard, and in an instant four of the gorillamen were dashing toward me.

"What do you here?" shouted one, and then as he recognized me, "Ho! It is the slave who claims to be from another world!"

They led me before a slimy Mahar who clung to a slimy rock within the large room that was the thing's office. With cold, reptilian eyes the creature seemed to bore through the thin veneer of my deceit and read my inmost thoughts.

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your own free will, because you think yourself better off here than elsewhere—do you not know that you may be the next chosen to give up your life in the interests of the wonderful scientific investigations that our learned ones are continually occupied with?"

I hadn't heard of anything of that nature, but I thought best not to admit it.

The Mahar looked at me in silence. The creature seemed deep in thought. Presently he communicated some message to the Sagoth. The latter turned, and motioning me to follow him, left the presence of the reptile. Behind and on either side of me marched the balance of the guard.

"What are they going to do with me?" I asked the fellow at my right.

"You may be sentenced to the arena, or go to the pits to be used in research work by the learned ones," he replied.

"And what will they do with me there?" I persisted.

"No one knows except the Mahars and those who go to the pits with them, but as the latter never return, their knowledge does them but little good. It is said that the learned ones cut up their subjects while they are yet alive, thus learning many useful things. However, I should not imagine that it would prove very useful to him who was being cut up; but of course this is all but conjecture."

To my surprise they returned me to the same building in which I had been confined with Perry and Ghak before my escape. At the doorway I was turned over to the guards there.

"He will doubtless be called before the investigators shortly," said he who had brought me back, "so have him in readiness."

The guards in whose hands I now found myself, upon hearing that I had returned of my own volition to Phutra, evidently felt that it would be safe to give me liberty within the building as had been the custom before I had escaped, and so I was told to return to whatever duty had been mine formerly.

My first act was to hunt up Perry, whom I found poring as usual over the great tomes that he was supposed to be merely dusting and rearranging upon new shelves.

As I entered the room he glanced up and nodded pleasantly to me, only to resume his

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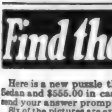

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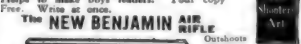

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LOST INSIDE THE EARTH

work as though I had never been away at all.

"Why, Perry!" I exclaimed, "haven't you a word for me after my long absence?"

"Long absence!" he repeated in evident astonishmnt. "What do you mean?"

"Are you crazy, Perry? Do you mean to say that you have not missed me since that time we were separated by the charging thag within the arena?"

"That time', " he repeated. "Why man, I have but just returned from the arena!"

"Perry, you *are* mad," I exclaimed. "Why, the Lord only knows how long I have been away. I have been to other lands and discovered a new race of humans within Pellucidar. I must have been away for months, Perry!"

The old man looked at me for a long time before he spoke. There was a puzzled expression upon his wrinkled face, and a look of hurt sorrow in his eyes.

"David, my boy," he said, "how could you for a moment doubt my love for you? There is something strange here that I cannot understand. You are positive that months have gone by, while to me it seems equally certain that not more than an hour ago I sat beside you in the amphitheater. Can it be that both of us are right and at the same time both are wrong? First tell me what time is, and then maybe I can solve our problem. Do you catch my meaning?"

I did. and said so.

"Yes," continued the old man, "we are both right. To me, bent over my book here, there has been no lapse of time. I have done little or nothing to waste my energies and so have required neither food nor sleep. but you, on the contrary, have walked and fought and wasted strength and tissue which must needs be rebuilt by nutriment and food, and so, having eaten and slept many times since last you saw me you naturally measure the lapse of time largely by these acts. As a matter of fact, David, I am rapidly coming to the conviction that there is no such thing as time—surely there can be no time here within Pellucidar, where there are no means for measuring or recording time."

It was too big a subject for me, and I said so, but Perry seemed to enjoy nothing better than speculating upon it until he was interrupted by the entrance of a Sagoth.

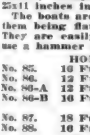
LOST INSIDE THE EARTH

"Come!" commanded the intruder, beckoning to me. "The investigators would speak with you."

"Good-bye, Perry!" I said, clasping the old man's hand. "There may be nothing but the present and no such thing as time, but I feel that I am about to take a trip into the hereafter from which I shall never return."

"I cannot believe but that you will return, David," he said. "It would be awful to think of living out the balance of my life without you among these hateful and repulsive creatures. If you are taken away I shall never escape for I feel that I am as well off here as I should be anywhere within this buried world. Good-bye, my boy, good-bye!" and then his old voice faltered and broke, and as he hid his face in his hands the Sagoth guardsman grasped me roughly by the shoulder and hustled me from the chamber.

(David and Perry attempt to carry out their plan of exterminating the Mahars, only to encounter incredible dangers. Read the next chapters of this thrilling serial in the April issue, out March First.)



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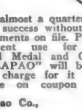

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Building the Heath Parasol

(Continued from page 65)

necessary to get the angle of incidence correct at the center of the wing over the fuselage. The angle of incidence is 2 degrees, and when it is correct the center of the bottom of the front wing spar will be 1 1/16" higher than the center of the bottom of the rear wing spar. When this is achieved, and it will probably be necessary to insert some thin plywood shims between the flattened portion of the top of the wing supporting struts and the wing spars to obtain proper adjustment, proceed to make the wing spars level throughout their length, using a common spirit level to check the jog. When the spars are finally level the wing will have a two degrees angle of incidence throughout its length. Now measure the distances between centers of the bolt holes of the wing strut fittings on the wing spars, and on the bottom longerons of the fuselage; these measurements will be the distance between centers of the end bolt holes of the respective wing struts.

The wing struts (see fig. 4, b,) are made of 7/8"x20 ga. Shelby steel tubing. A 6" length of the next size smaller tube is slipped into each end of each strut, and then it is flattened while red hot. The flattened ends are drilled for 1/4" bolts, being careful that the distances between centers are correct. A spruce fairing is attached to the back of each strut as shown in fig. 4, B, to give it a true streamline cross section. This fairing is gouged on its front, to fit the curvature of the tube, and tapered to a knife edge at the rear. It is laid up against the rear of the tube and fastened throughout its length with a wrapping of 2" cloth tape, which is heavily saturated with wing dope.

The external drag and anti-drag cables, that is, the cables that cross each other in the space between the wing struts, are of 1/8" hard cable strand with No. 324 single fork turnbuckles. Terminals of 16 ga. sheet steel, each drilled with a 1/4" and a 3/16" hole, are placed on the ends of the 1/4" bolts securing the wing struts to the wing strut fittings on spars and longerons. The cables are fastened to these lugs with a clevis at one end and a turnbuckle at the other. One cable runs from the front wing strut fitting on the bottom longeron, to the wing strut fitting on the rear wing spar. The other runs from the rear wing strut fitting on the bottom longeron, to the wing strut fitting on the front spar.

Building the Heath Parasol

Every bit of woodwork must be sandpapered to a satin-like smoothness. This increases the strength considerably. Any roughness that would make an unsightly lump on the wing after covering, must be smoothed.

Internal Finish of the Wings

All metal parts of the wings may be finished with three coats of black auto enamel. The object of this is to prevent dangerous rusting and corrosion, so thoroughness is necessary. All woodwork must be given a coat of shellac, and three coats of fine spar varnish, using special care in filling in the joints to prevent moisture gaining access to them.

Covering the Wings and Empennage

It requires 27 yards of airplane fabric to cover the wings and ailerons. A good grade of unbleached muslin, of light texture and fine weave, such as is used for household sheeting, can be used. The easiest method is probably to fold the cloth over the trailing edge, and tack it to the leading edge. The seams are of the "English Welt" or double lapped type, and this, of course, necessitates sewing before the fabric is placed on the wings. The kind of seam used in heavy overcoats is satisfactory. The seams should run parallel to the ribs. Cover the wings individually. Prepare a large piece of fabric 10'x13½'. Wrap the fabric about the wing and tack the cloth temporarily, here and there along the leading edge, using ¼" copper tacks. Tack it along the butt rib, and sew it together around the wing tip. Gradually tighten the cloth by retacking and resewing to remove all fullness and wrinkles. Trim away the excess cloth. Cut away the cloth in the aileron opening leaving about 2" overlap. Tack the cloth to the rear wing spar in the aileron opening, and to the plywood web of the last regular rib. Space the tacks about 3" apart. Have the edges of the cloth lap 1" along the leading edge, around the aileron opening and across the wing butt rib. Do a neat, smooth job. It is unnecessary to stretch the cloth very tightly, as the wing dope will give the cloth the tautness of a drum head. However, the cloth must be stretched very tightly across the leading edge from end to end to prevent the cloth being pulled down be-

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Building the Heath Parasol

tween the ribs, when dope is applied. Now cut 9' lengths of 3/8" binding tape and wrap one length snugly about the wing over each rib, tacking the ends down at the leading edge. Thread an 8" steel needle with linen rib sewing cord, and starting at the trailing edge, push the needle clear through the wing touching one side of a rib, and then bring it back through the wing on the other side of the rib. The result will be a loop of cord clear around the rib, including both top and bottom binding tapes, and the wing fabric under the tapes. Draw the loop tight and knot it on top of the rib. Move forward along the rib 4", letting the cord lie in a single strand on top of the rib and repeat the above operation with the knot again on top of the rib. Sew forward in this manner, looping and knotting at 4" intervals, until the leading edge is reached. see fig. 6. Do this to all the ribs. Now take 9' lengths of 1¼" pinked edged tape and wrap them on just as the binding tape was wrapped, with the ends meeting at the leading edge. This is a finishing tape to cover the stitches that hold the binding tape. This tape must be heavily saturated with wing dope and stuck down with a brush. The edges should be brushed out perfectly smooth. Run a 2" pinked edged tape across the leading edge, around the wing tip, and across trailing edge, as a reenforcement, and to hide the rows of tacks and stitches. Cut large strips of cloth to tape the butt rib and the edges of the aileron opening. The edges of these pieces should be frayed, should overlap about 1", and should be doped down on the upper and lower surfaces of the wing. Dope dries immediately and holds like glue. It is not much different from liquid court-plaster. The entire wing must now be given two coats of clear wing dope and two coats of pigmented dope for a nice color finish. Do not use more coats of dope than this as the ribs will buckle and break due to the tighter cloth. The ailerons are covered and finished exactly as the wings are. The tail surfaces are covered and finished in the same way, excepting that no tacking should be done as it will split the small woodwork. The cloth should be folded over the hinge spars and sewed around the outline. It is best to give the tail surfaces but one coat of clear dope and two coats of pigmented dope as more will cause the light structure to buckle when the cloth tightens.

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Building the Heath Parasol

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Have the plane complete except for installation of the large monoplane wings. Put a weight in the pilot's seat equal to the weight of the pilot's body, and another long object on the floor corresponding to the weight of his legs. Make a light, stiff, wooden frame to go under the fuselage, with its corners supporting the longerons just under the wing strut fittings on the longerons. This frame may be made of four pieces of 2"x4" wood, somewhat like a window frame for a shed. Now balance the complete fuselage, while it is sitting on this frame, on a saw horse having a heavy wooden knife-edged piece on top, and set at right angles to the length of the fuselage. The frame holding the fuselage will rest on the sharp wooden edge, and the whole affair will be somewhat like a teeter-totter. Change the fore and after location of the saw horse until the ship balances with its top longerons level. Tie a string with a plumb-bob on its end to a top longeron, and change its position fore and aft, until the plumb bob hangs directly over the sharp edge of the saw horse which supports the fuselage. When the wing is properly installed, or rigged, the straight vertical line represented by the plumb line will pass upward cutting through the wing at a point 15½" back from the leading edge. This is the experimental and best method of adjusting a new ship for flight. A plane so adjusted will practically fly itself in smooth air. With the data gained in this manner the accurate rigging of the wing is not difficult. Two ⅛" cables with No. 324 single fork turnbuckles and terminals, should be made up, and installed between the tops of the front and rear wing supporting struts. Their terminals should be held by the bolts of the connections of left and right wings. These cables must be tightened slightly to take fore and aft tension between the wing spars.

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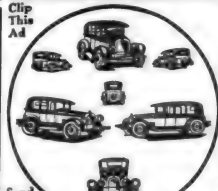

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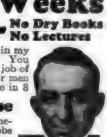

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Please send me FREE BOOK on Auto Mechanics, and details of special railroad fare and tuition offer.

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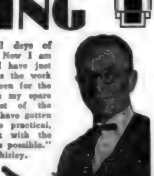
"I feel as though my old days of drudgery were a bad dream. Now I am earning $5,200.00 a year and I have just started. Commercial drawing is the work I love to do. If it had not been for the opportunity of studying art in my spare time, and the kindly interest of the Federal faculty, I would never have gotten out of the rut I was in. The practical, thorough, short course I took with the Federal School made my success possible."
—Lloyd Shirley.



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Yes—I'll pay you $30 a day to show my marvelous line of rain-proof, made-to-measure Fits-U Caps to men. More for active workers. With my liberal commission of $1.00 on every sale, it's a cinch to clean up $5.00 or more an hour in spare time alone. "In two hours," writes one successful salesman, "I made $15.70. It's the rain-proof and made-to-measure features that get the orders quick." By a secret process every Fits-U Cap is made absolutely rainproof! Rain or snow has no effect on Fits-U Cap. You collect big commission in advance. EVERY CAP MADE TO INDIVIDUAL MEASURE! Also show men's fine hats, women's charming hats, mufflers, ties, etc., all fast sellers.

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Fits-U salesmen wear sample caps to show to customers. You can get one made to your own measure without paying one cent. New plan makes bonus of 10 free caps a month easy!

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I'll send you elaborate selling outfit FREE. Get started immediately. Just send name and address. Postal will do. Hurry! Write today!

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Building the Heath Parasol

The elevators are adjusted so that when the stick is central, pushed neither downward nor back, they form a direct continuation of the horizontal stabilizer.

When the rudder bar is neutral, pushed neither on its left nor right end, the rudder is neutral, turned neither left nor right.

Lubricate the control system with light oil and see that it operates smoothly and with no noticeable lost motion. See that all cowling is tightly fastened and in no danger of blowing loose. Make sure that everything is fastened to stay secure indefinitely. See that the safety belt is all right, and that its buckle can be quickly fastened and undone. Strain the gasoline through chamois skin. Oil the wheels.

Test Flying the "Super-Parasol"

No one should attempt to test fly a new ship who has less than twenty-five flying hours to his credit. However, it has been done with less experience, and probably can be done again, as many of the old timers taught themselves to fly, and on no such good plane as the modern "Super-Parasol."

To test the new plane take it to a large, smooth field—wheat stubble is usually all right, smooth pasture is excellent, oats stubble is all right if there are not too many old corn stalks in it, and hay stubble is often good. The larger the field, the better and safer it is.

Pick a cool, grey day with little or no wind, a quiet dawn, or quiet evening at sunset for the initial flight. Fine, warm days nearly always have bumpy air, and are bad for beginners and for test flying.

Having found a large, smooth field, and perfect weather conditions, warm up the motor, see that it turns up to 2,800 R. P. M. on the tachometer, and that the oil pressure is from 75 to 100 lbs. Set the altimeter to read zero feet on the ground.

Practice a few take-offs heading directly against the breeze, if there is one, taking the ship up only about five feet, and landing at once so as to not bump the fence at the end of the field. Watch the plane very closely for peculiarities.

When certain that everything is perfect, give the motor full throttle and take off on a long, flat climb and gain 1,500 feet on the altimeter before making the first turn, and when it is made fly right back to

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RENOWNED IRON TONIC PILLS

A general tonic to tone up the body, improve and build up the blood supply. Especially to weak, thin, bloodless, pale, nervous, run-down men and women. Promotes action of the stomach, liver, kidneys and bowels. Makes you eat better—work better and feel better. You may eat or drink anything while taking these pills. Full month's treatment $1.00, Postage Paid. Dr. Warner's booklet on Personal Hygiene for women and girls sent free on request.

WARNER'S RENOWNED REMEDIES CO.,
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Make 16-foot Rowboat. Blueprint, 30c. Wee-Sho-U Co., 31st Postal Office, Detroit, Mich.

This Little Engine Delivers 1 H. P.

REAL GAS ENGINE for MODEL AIRPLANES

It is a 2-cycle, 3-port air-cooled aluminum alloy engine which develops 1 h. p. on a weight of only 5 lbs. It will run any ordinary canoe or small row boat, and has plenty of power to run a light motorcycle. It is 2 in. in bore by 1⅝ in. stroke, 8¼ in. high from bottom of crank case to top of cylinder, and but 3¾ in. between base supports. The outside diameter of the cylinder is but 3½ in.

A suitable size of model plane for this engine would be: A monoplane of 9 to 12 ft. wing span, with the Fokker cantilever type of wing, having a fuselage 10 to 12 in. square. The elevator and stabilizing unit should be about 4 to 6 ft. from the trailing edge of the wing. A good wing section would be the N. A. C. A. No. 6, dimension of which can be secured from the National Advisory Committee for Aeronautics, Navy Bldg., Washington, D. C. This wing section of the thick type has a constant pressure, and once the plane is balanced while at rest, it will fly balanced at all angles of lift.

Free—Bulletin 64, describing this and other engines. Address:
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DYNAMIC MFG. CO.,
FIRST NATIONAL BANK BLDG. CHICAGO

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Amazing, startling FACTS that Science has actually discovered and PROVEN about AFTER-DEATH and LOVED ONES gone BEYOND sent for 10c in stamps.
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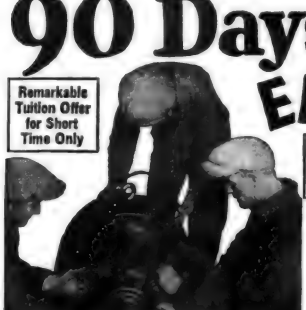

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"Cleans Up" for Agents

$90 WEEKLY IN SPARE TIME!

Men, here is a wonder—the most sensational invention of the age! If you're looking for a rapid fire seller—an item that nets you 100% profit—an item that sells itself to 7 out of 10 men on demonstration—I've got it in Ve-Po-Ad, the amazing new vest pocket address machine!

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Live wire salesmen are dropping everything else and flocking to Ve-Po-Ad. Ve-Po-Ad brings them quick money and lots of it. Shapiro cut in California made $475 in one week! You can "clean up" too! Only 10 sales a day in spare time will bring YOU over $65.00 a week! You need no previous sales experience—Ve-Po-Ad sells itself! If you are really interested in earning a steady, substantial income, write at once for full details of my MONEY-MAKING PLAN and FREE VE-PO-AD given to new Agents. DO IT NOW—TODAY!

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KARAS ELECTRIC COMPANY
4051C N. Rockwell St., Chicago, U. S. A.

Name .....
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City and State 4051C

Building the Heath Parasol

the field and fly around it to gain altitude slowly.

At about ¾ throttle the plane should fly level, hands off; at full throttle it should climb, hands off, and at less than ¾ throttle it should descend. If it does these things, it is in perfect adjustment. Tail heaviness can be corrected by moving the wing back about 1½" or 2"; nose heaviness by moving the wing forward the same distance.

The MOCAR

BOYS MODEL AIRPLANES THAT FLY

—Here's the greatest value you've ever seen, a genuine aluminum model airplane that really flies. At a small price. The "Mocar" monoplane—Set No. 1—is a copy of Lindbergh's famous Spirit of St. Louis. Wing spread 18 inches, fuselage 13 inches, powerful motor, special propeller, rubber-tired disc wheels. Weight complete only about 2½ oz.

This is a practical, simple, real model plane that gives you a whole lot of fun at a very moderate cost. The all-metal construction makes a sturdy plane that will stand a "c" of abuse. The outfit is mounted on cardboard with all parts plainly marked, and full instruction for assembly. Pliers only tool necessary. Construction Set No. 1 complete with rivets, bolts, wheels, wing and fuselage covering material, only $1.50 postpaid (3 for $4). Model L made up ready to fly $2.25 (3 for $6) ppd. Great fun, learn how to make and fly airplanes.

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BROWNIE NAME CARDS

Latest Handy Size.

50 Perfect Name Cards and Case 10c.
Size 1¼×2¼. Choice of old English, Plain or Script type.
Address - - - 10c Extra
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With Novelty case and Fancy box. Send Stamps, Coin, or Money Order. Satisfaction Guaranteed or Money refunded. Agents Wanted.

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My latest improved Model 25 corrects now ill-shapednoses quickly, painlessly, permanently and comfortably at home. It is the only nose-shaping appliance of precise adjustment and a safe and guaranteed patent device that will actually give you a perfect looking nose. Write for free booklet which tells you how to obtain a perfect looking nose.

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It is a profession which offers almost unlimited opportunities for advancement to men who combine natural mechanical ability with special technical training.

For this is the age of machinery. Almost every convenience, luxury or necessity which we enjoy today depends on machinery for its production or adaptability to our needs. Every new invention multiplies the opportunities for competent designers, builders, erecting engineers, etc.

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Without cost or obligation, please send me one of your booklets and tell me how I can qualify for the position or in the subject *before* which I have marked an X:

☐ Mechanical Engineering	**☐ Draftsmen's Course**	**☐ Shop Practice**	**☐ Toolmaking**		**☐ Patternmaking**
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City.....State.....

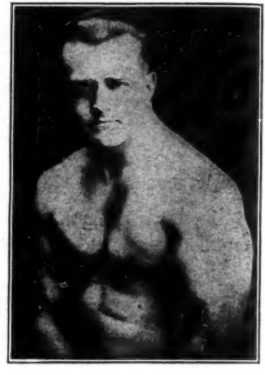
Persons residing in Canada should send this coupon to the International Correspondence Schools Canadian, Limited, Montreal, Canada

The Man I Pity Most

POOR OLD JONES. I see him now, standing there, dejected, cringing, afraid of the world. No one had any use for him. No one respected him. Across his face I read one harsh word—FAILURE. He just lived on. A poor worn out imitation of a man, doing his sorry best to get on in the world. If he had realized just one thing, he could have made good. He might have been a brilliant success.

There are thousands and thousands of men like Jones. They, too, could be happy, successful, respected and loved. But they can't seem to realize the one big fact—that practically everything worth while living for depends upon STRENGTH—upon live, red-blooded, he-man muscle.

Everything you do depends upon strength. No matter what your occupation, you need the health, vitality and clear thinking only big, strong virile muscles can give you. When you are ill the strength in those big muscles pulls you through. At the office, in the farm fields or on the tennis courts, you'll find your success generally depends upon your muscular development.



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Author of "Muscle Building," "Science of Wrestling," "Secrets of Strength," "Here's Health," "Endurance," Etc.

Here's a Short-cut to Strength and Success

But, you say, "It takes years to build my body up to the point where it will equal those of athletic champions." It does if you go about it without any system, but there's a scientific short-cut. And that's where I come in.

30 Days Is All I Need

People call me the Muscle-Builder. In just 30 days I can do things with your body you never thought possible. With just a few minutes' work every morning, I will add one full inch of real, live muscle to each of your arms, and two whole inches across your chest. Many of my pupils have gained more than that, but I GUARANTEE to do at least that much for you in one short month. Your neck will grow shapely, your shoulders begin to broaden. Before you know it, you'll find people turning around when you pass. Women will want to know you. Your boss will treat you with a new respect. Your friends willwonder what has come over you. You'll look ten years younger,and you'll feel like it too. Work will be easy. As for play, why, you'll realize then that you don't know what play really means.

I Strengthen Those Inner Organs Too

But I'm not through with you. I want ninety days in all to do the job right, and then all I ask is that you stand in front of your mirror and look yourself over.

What a marvelous change! Those great squared shoulders! That pair of huge, lithe arms! Those firm, shapely legs! Yes, sir. Those are yours, and they are there to stay. You'll be just as fit inside as you are out, too, because I work on your heart, your liver—all of your inner organs, strengthening and exercising them. Yes, indeed. life can give you a greater thrill than you ever dreamed. But, remember, the only sure road to health, strength and happiness *always demands action.* Fill out the coupon below and mail it today. *Write now!*

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It contains forty-eight full-page photographs of myself and some of the many prize-winning pupils I have trained. Some of these came to me as pitiful weaklings, imploring me to help them. Look them over now and you will marvel at their present physiques. This book will prove an impetus and a real inspiration to you. It will thrill you through and through. This will not obligate you at all, but for the sake of your future health and happiness do not put it off. Send today—right now before you turn this page.

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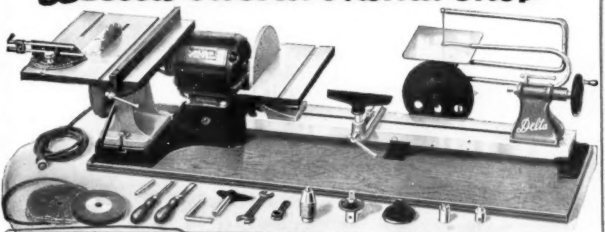
Here is a Husky Man-Size Workshop

The New 1929 Model Complete, Practical "Delta" Electric Handi-Shop



New Features of 1929 Model

found **exclusively** in the "Delta" Handi-Shop, in addition to the many regular advantages, include:

New Delta Miter-Gauge (with many new features)

New Circular Saw Adjusting Lever

New Delta Adjustable Rip Gauge

Larger Circular Saw Table

One-third H. P. Motor

Larger Triple Foundation Lathe Bed

½-in. Capacity Drill Chuck

For full details, send coupon below.

Make the Things You Have Always Wanted to Make

It's so easy and so quick with the Handi-Shop. Save money on repair work. Earn money in your spare time. Complete instructions and Blue Prints furnished. A few of the hundreds of articles you can make with the "Handi-Shop" shown below.

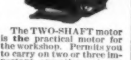
Blue Prints Included

Does Everything from Building Full-Sized Furniture to Turning 36" Table Legs

Note the **two-shaft motor** that permits **two** or **three** operations **at one time**—the heavy Triple Foundation U-Shaped Lathe Bed (no rods)—the **practical** arrangement of the Circular Saw that permits the cutting of large lumber without interference—the Improved Tilting Tables on the Circular Saw, Sanding Disc, and Jig Saw. Has **automatically oiled** bronze bearings and is **completely assembled** on heavy veneered wood base.

The TWO-SHAFT motor is the practical motor for the workshop. Permits you to carry on two or three important operations at one time **without continually dismantling** set-up.

This combination of advantages, plus many more, IS FOUND EXCLUSIVELY IN THE "DELTA" HANDI-SHOP! **And now, with the many additional exclusive features of the new 1929 model, this shop is in a class by itself—above all comparison—at a new price that is surprisingly low.**



Heavy Triple Foundation U-Shaped Lathe Bed (not rods or rails) is guaranteed not to spring or chatter.

10-DAY TRIAL IN YOUR OWN HOME

without obligation. See how PRACTICAL, how EFFICIENT is this sturdy, full-sized machinery under **actual working conditions.** Study its many exclusive advantages. You will find the Handi-Shop complete with all necessary equipment for **Circular Sawing, Wood-turning, Jig Sawing, Sanding, Drilling, Grinding and Buffing.**

Easy Terms

Then if you decide to keep the Handi-Shop, you can have your choice of three convenient methods of payment.

Write for Valuable Book

crammed with practical information on how to construct useful and decorative objects. Illustrated.

If you want this book, enclose 10c to cover mailing cost. See Coupon.

Send Coupon

at once for FREE beautifully illustrated literature giving complete description of the New 1929 Model "Delta" Handi-Shop, and full details of the 10-day Trial Offer and Convenient Payment Plans.

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☐ Please send me copy of "How to Make Things with a Workshop." I enclose 10c to cover cost of mailing.

Name.....

Address.....

30 Selections

$11.25 worth of high grade 75c records included in this offer. 30 selections—15 double face records. Made by the *new electric process;* more life like, more volume, less surface noise. Play longer. Very latest popular songs, dance music, band and instrumental pieces. Read our wonderful offer.

with this

Portable Phonograph

$1.00 *down* brings it on 30 Days Trial

Folds Like a Suitcase with snap locks and carrying handle. So light and convenient — easily carried wherever you want it.

Plays any standard 10-inch disc record. Plays two ten-in. records with one winding. Weight 17 lbs. Waterproof imitation leather case, with hinged lid. Size 16 x 12 x 8½ in. Records inside of lid are secured so they will not rattle or break. Holds 15 records. Has quiet spring motor, tone arm and reproducer with indestructible diaphragm and wide throat for full sound volume. Outfit includes 15 double face 75c New Electric Process Records—30 selections. Shipping weight packed about 25 lbs.

Order by No. W3136WA—only $1.00 with coupon, $2.50 monthly. Total price, $24.95

Yes, only $1.00 with coupon below brings you this portable phonograph with a special assortment of 15 latest double-face 75c *new electric process* records—30 selections in all. Think of it—$11.25 worth of brand new records included on this sensational offer! Use this wonderful portable as your own. See what a wonderful convenience it is to have a phonograph that you can carry wherever and whenever you want it.

We guarantee: that you get everything in this phonograph so far as concerns music reproduction that a $250 phonograph can give you, also exact reproducer, exact style of tone arm and the same grade of records. That's why you get, on this wonderful offer, **absolutely the best in music that any phonograph ever gave.**

$2.50 a Month

If within 30 days you decide not to keep the outfit, send it back and we'll refund your $1.00 plus all transportation charges. If you keep it, pay only $2.50 a month until you have paid that sensational price on this special sale—only $24.95.

Think of it, a first class high grade phonograph and 15 latest double face Records (30 selections) a complete outfit, ready to play, only **$24.95!** Seize this opportunity while it lasts! Send the coupon NOW!

Free Catalog of home furnishings sent on request with or without order. See coupon.

Straus & Schram, Dept. 4733 Chicago

New Portable Phonograph

Light and easy to carry. Ideal for every purpose. Plays all records with wonderful tone and volume. Beautifully covered in red Baby Alligator genuine DuPont Fabricoid (absolutely waterproof.) This portable is equipped with many new, exclusive features, including a long air column horn of the newest type, the finest reproducer on the market, a strong pulling, even running motor, double nickeled hardware throughout, self contained album to conveniently carry 15 records.

Send Coupon Now

Straus & Schram, Dept. 4733 Chicago, Ill.

Enclosed find $1. Ship special advertised Puritone Portable Phonograph with 15 Double Face 75c *New Electric Process* records—30 selections. I am to have 30 days free trial. If I keep the outfit, I will pay you $2.50 monthly. If not satisfied, I am to return the phonograph and records within 30 days and you are to refund my dollar and express charges I paid.

Puritone Portable Phonograph and 15 Double Face Records, W3136WA, $24.95.

Name.....

Street, R.F.D. or Box No......

Shipping Point.....

Post Office..... *State*.....

Married or Single..... *Nationality or Color*.....

If you want only our free catalog of home furnishings, mark X here ☐